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ABSTRACT

The Ninth Federal Forecasters Conference provided a forum in which forecasters from different federal agencies and other organizations could meet to discuss various aspects of forecasting in the United States. The theme was "Forecasting in an Era of Diminishing Resources." The conference was attended by 150 forecasters. A keynote address by Katharine G. Abraham, Commissioner of Labor Statistics, and a panel discussion set the stage for 2 concurrent sessions in the afternoon at which 26 papers were presented. These papers, or in a few cases an abstract, are included in this volume grouped into topics of: (1) "The Economic Outlook"; (2) "Industry Modeling at the Bureau of Labor Statistics"; (3) "Global Forecasting and Foresight"; (4) "Community Policy Models"; (5) "Topics in Forecasting"; (6) "Forecasting Crop Prices under New Farm Legislation"; (7) "Forecast Evaluation"; (8) "Early Warning and the Need for Information Sharing"; and (9) "Forecasting Program Expenditures." Of particular interest to the educational research community were two papers. The first, "The Educational Requirements of Jobs: A New Way of Looking at Training Needs" by Darrel Patrick Wash of the Bureau of Labor Statistics, is presented as an abstract. The second, "Projections of Elementary and Secondary Public Education Expenditures by State" by William J. Hussar of the National Center for Education Statistics, is a discussion of estimation and data pooling techniques and projection models. (Contains 83 tables and 37 figures.) (SLD)

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The Ninth Federal Forecasters Conference - 1997

Papers and Proceedings

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Announcement

The 10th
Federal Forecasters Conference
(FFC-99)

will be held

on

June 24, 1999

in

Washington, DC

More information will be available in the coming months.

The Ninth Federal Forecasters Conference - 1997

Papers and Proceedings

Edited by
Debra E. Gerald
National Center for Education Statistics

U.S. Department of Education
Office of Educational Research and Improvement

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Federal Forecasters Conference Committee

(Left to right) **Peg Young**, Department of Veterans Affairs, **Stuart Bernstein**, Bureau of Health Professions, **Howard N. Fullerton, Jr.**, Bureau of Labor Statistics, **Norman C. Saunders**, Bureau of Labor Statistics, **Paul Campbell**, Bureau of the Census, **Jeffrey Osmint**, U.S. Geological Survey, **Karen S. Hamrick**, Economic Research Service, and **Debra E. Gerald**, National Center for Education Statistics. (Not pictured): **Stephen A. MacDonald**, Economic Research Service, **John H. Phelps**, Health Care Financing Administration, and **Clifford Woodruff**, Bureau of Economic Analysis.

Foreword

In the tradition of past meetings of federal forecasters, the Ninth Federal Forecasters Conference (FFC-97) held on September 11, 1997, in Washington, DC, provided a forum where forecasters from different federal agencies and other organizations could meet and discuss various aspects of forecasting in the United States. The theme was "Forecasting In An Era of Diminishing Resources."

One hundred and fifty forecasters attended the day-long conference. The program included opening remarks by Norman C. Saunders and welcoming remarks from Katharine G. Abraham, Commissioner of Labor Statistics from the Bureau of Labor Statistics. Katherine K. Wallman, Chief Statistician of the United States Office of Management and Budget, delivered the keynote address. The address was followed by a panel discussion with comments from Katharine G. Abraham, J. Steven Landefeld, Director of the Bureau of Economic Analysis, and Alan R. Tupek, Deputy Director, Division of Science Resources Studies, National Science Foundation. Paul Campbell of the Bureau of the Census and Jeffrey Osmint of U.S. Geological Survey presented awards for 1996 Best Conference Paper and a Special Award for Presentation. Debra E. Gerald of the National Center for Education Statistics and Karen S. Hamrick of the Economic Research Service presented awards from the 1997 Federal Forecasters Forecasting Contest.

In the afternoon, two concurrent sessions were held featuring 26 papers presented by forecasters from the Federal Government, private sector, and academia. A variety of papers were presented dealing with topics related to agriculture, the economy, education, health, labor and issues regarding community policies, forecast evaluation, futures research, and global forecasting. These papers are included in these proceedings. Another product of the FFC-97 is the *Federal Forecasters Directory 1997*.

Acknowledgments

Many individuals contributed to the success of the Ninth Federal Forecasters Conference (FFC-97). First and foremost, without the support of the cosponsoring agencies and dedication of the Federal Forecasters Organizing Committee, FFC-97 would not have been possible. Debra E. Gerald of the National Center for Education Statistics served as lead chairperson and developed conference materials. Jeffrey Osmint of the U.S. Geological Survey organized the keynote presentation and Norman C. Saunders of the Bureau of Labor Statistics organized the panel discussion. Stephen M. MacDonald of the Economic Research Service (ERS) prepared the announcement and call for papers and provided conference materials. Karen S. Hamrick of ERS organized the afternoon concurrent sessions and conducted the Federal Forecasters Forecasting Contest. Howard N Fullerton, Jr., of the Bureau of Labor Statistics secured conference facilities and handled logistics. Peg Young of the Department of Veterans Affairs provided conference materials.

Also, recognition goes to Stuart Bernstein of the Bureau of Health Professions, Paul Campbell of the Bureau of the Census, John H. Phelps of the Health Care Financing Administration, and Clifford Woodruff of the Bureau of Economic Analysis for their support of the Federal Forecasters Conference.

A special appreciation goes to Peg Young and the International Institute of Forecasters for their support of this year's conference.

A deep appreciation goes to Thomas F. Hady, retired from the Economic Research Service, for reviewing the papers presented at the Eighth Federal Forecasters Conference and selecting awards for the 1996 Best Conference Paper and a Special Award for Presentation.

In addition, many thanks go to Linda D. Felton and Patricia A. Saunders of the Economic Research Service for assembling the conference materials into packets and staffing the registration desk.

Last, special thanks go to all presenters, discussants, and attendees whose participation made FFC-97 a very successful conference.

1997 FEDERAL FORECASTERS FORECASTING CONTEST

WINNER

Tancred C. M. Lidderdale
Energy Information Administration

HONORABLE MENTION

Ken Beckman, U.S. Geological Survey
Patrick Walker, Administrative Office of the United States Courts
Thomas D. Snyder, National Center for Education Statistics
Joel Greene, Economic Research Service
Peggy Podolak, U.S. Department of Energy
John Golmant, Administrative Office of the United States Courts
W. Vance Grant, National Library of Education
Betty W. Su, Bureau of Labor Statistics
David Torgerson, Economic Research Service

CONTEST ANSWERS

U.S. Civilian Unemployment Rate **4.9%**
Treasury Bond Ask Yield **6.64%**
Cash Price of Cotton **$0.7090**
Average Temperature **72.5°**
Lead team in the American League East Winning Percentage **0.625**

1996 BEST CONFERENCE PAPER

WINNER

"An Interactive Expert System for Long-Term Regional Economic Projections"

Gerard Paul Aman
Bureau of Economic Analysis

HONORABLE MENTION

"Beyond Ten Years: The Need to Look Further"

R.M. Monaco
University of Maryland

John H. Phelps
Health Care Financing Administration

"California's Growing and Changing Population: Results from the Census Bureau's 1996 State Population Projections"

Larry Sink
Bureau of the Census

SPECIAL AWARD FOR PRESENTATION

"World Agriculture to 2005"

Stephen A. MacDonald (Chair)
Jaime A. Castaneda
Mark V. Simone
Carolyn L. Whitton
Economic Research Service

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The Ninth
Federal Forecasters Conference
Forecasting in an Era of Diminishing Resources

Photos by Department of Labor Staff Photographer

Forecasting In An Era of Diminishing Resources

Keynote Speaker: **Katherine K. Wallman**
Office of Management and Budget

Panelists:

Katharine G. Abraham
Commissioner of Labor Statistics
Bureau of Labor Statistics, U.S. Department of Labor

J. Steven Landefeld
Director
Bureau of Economic Analysis, U.S. Department of Commerce

Alan R. Tupek
Deputy Director
Division of Science Resources Studies
National Science Foundation

This session examined the federal forecasters' role in a shrinking federal sector. The critical scrutiny of the government's role in society has affected federal forecasting. Budgetary realities, widespread skepticism regarding efficacy of social engineering, and spending priorities have cut resources available to many forecasting agencies—often drastically. The outlook for forecasting resources at the individual and institutional level is very uncertain.

The keynote speaker and panelists looked at the appropriate role of the public sector in an information economy; how forecasters can maintain timely, reliable forecasting with shrinking resources for themselves and fellow agencies; and how forecasters can contribute to answering these questions for policymakers and the public.

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Katherine K. Wallman, Chief Statistician, Office of Management and Budget delivers the keynote address.

The Ninth Federal Forecasters Conference was held on September 11, 1997 at the Bureau of Labor Statistics. These photos highlight the morning session.

Katherine K. Wallman makes a point about collaboration among federal agencies.

John H. Phelps, Health Care Financing Administration, poses a question to the panelists.

Katharine G. Abraham and **J. Steven Landefeld** address questions from the audience.

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Katharine G. Abraham, Commissioner of Labor Statistics, Bureau of Labor Statistics (right), **J. Steven Landefeld**, Director, Bureau of Economic Analysis (below left), and **Alan R. Tupek**, Deputy Director of Division of Science Resources Studies, National Science Foundation (below right), lead off the panel discussion on getting the job done with fewer resources in the wake of downsizing.

Following the morning session, **Debra E. Gerald**, National Center for Education Statistics (NCES) presents an award to one of the 1997 Federal Forecasters Forecasting Contest winners, **Thomas D. Snyder**, NCES.

Concurrent Sessions I

THE ECONOMIC OUTLOOK

Chair: Ed Gamber
Congressional Budget Office

The Economic Outlook (Abstract),
Ed Gamber, Congressional Budget Office

U.S. Economic Outlook for 1998 and 1999,
Paul A. Sundell, Economic Research Service, U.S. Department of Agriculture

The Long-Term Economic Outlook: Is This the Era of Diminishing Resources?
R. M. Monaco, INFORUM, Department of Economics, University of Maryland

Discussant: Herman O. Stekler
Department of Economics, The George Washington University

The Economic Outlook

Chair: Ed Gamber
Congressional Budget Office

The U.S. economy is currently in its seventh year of expansion with the unemployment rate at a 23 year low and the inflation rate (by some measures) falling. How long can this economic nirvana last? Will growth slow on its own or will the Federal Reserve step on the brakes? Will inflation remain unbelievably calm or will it soon begin to rise? Over the longer term, what are the prospects for economic growth over the next 5 to 10 years? This panel discussion will present varying viewpoints on these and related questions about the economic outlook for the United States. Ed Gamber will discuss the short-term outlook (the current and next quarter). Paul Sundell will discuss the two-year outlook and Ralph Monaco will discuss the 5- to 10-year outlook. Herman Stekler will critique the forecasts.

Panelists:	Ed Gamber Congressional Budget Office
	Paul Sundell Economic Research Service, U.S. Department of Agriculture
	R. M. Monaco INFORUM, Department of Economics, University of Maryland
Discussant:	Herman O. Stekler Department of Economics, The George Washington University

U.S. ECONOMIC OUTLOOK FOR 1998 AND 1999

Paul A. Sundell, USDA Economic Research Service

Real GDP is expected to grow 2.6 percent in 1998 and slow to 2.3 percent in 1999. Growth in 1998 will be aided by the strong economic momentum of 1997. Economic growth will continue to benefit from a continuation of recent higher productivity trends, low inflation, and only modest additional tightening of monetary policy in the spring of 1998. Only a modest tightening of monetary policy is expected in 1998 given the outlook of only a small increase in inflation coupled with continued moderate gains in productivity, and moderating growth in the final demand for goods and services. Economic growth will be held down by expected much slower inventory growth in 1998.

Real GDP growth is expected to slow to 2.3 percent in 1999. Slower growth relative to 1998 will be caused by tighter resource markets, coupled with the lagged effects of higher interest rates in 1998, a slowing in the extremely rapid pace of business equipment investment, a modest increase in the rate of consumer saving out of personal disposable income, and slightly higher inflation. Productivity growth is expected to remain moderate by historical standards and average slightly over one percent rate in 1999. Productivity will continue to gets a boost from strong competitive pressures and the continuation of strong business investment in the post-1993 period.

Tight Labor and Product Markets to Constrain Growth and To Put Mild Upward Pressure on Inflation

Thus far, through the third quarter of 1997, there is no significant evidence of accelerating price pressures in terms of the broad price indices. The favorable inflation performance in 1997 has been aided by broad-based favorable price developments, in the following areas: employee benefit costs, falling energy and import prices, and a continued moderate level of worker uncertainty. A moderate level of worker uncertainty has occurred despite a low overall unemployment rate, high labor force participation, and a relatively long average work week in the private sector. In 1998 and 1999, price movements in employee fringe benefits, energy, and imports are not expected to be nearly as favorable. Likewise, the continuation of very low rates of unemployment coupled with continued moderate gains in worker productivity and strong corporate balance sheets and profitability point toward stronger wage growth in 1998 and 1999.

Overall labor market data indicate tight overall labor market conditions. The September 1997 unemployment rate stood at 4.9 percent. Historically, the unemployment rate has not been below 5.0 percent for a prolonged period since 1973. In 1997, labor force participation rates have reached an all time high. The average private nonfarm workweek and overtime hours in manufacturing have remained high by historical standards since 1993. Most Federal Reserve Districts are reporting growing shortages of skilled labor. Historically, such signs of prolonged labor market tightness have normally been associated with accelerating inflation.

Capital goods markets are moderately tight by historical standards. Overall capacity utilization in August stood at 83.9 percent while capacity utilization in manufacturing stood at 83.1 percent. Over time, prolonged capacity utilization in the manufacturing sector above 82 percent generally has been associated with periods of rising inflation. Tight factor markets typically slow economic growth by generating slower deliveries of goods and services and by raising inflation. Higher inflation slows economic growth by raising economic uncertainty through increasing uncertainty concerning inflation and therefore expected real returns to labor, capital, and financial investment.

Favorable price movements have occurred in 1997 in terms of very mild increases in employee fringe benefit costs, sharply lower energy prices, and a strong dollar. These favorable relative price movements have helped keep inflation very low. Employer fringe benefits costs increased by only 1.4 percent on a seasonally adjusted annualized basis in the first half of 1997. Crude energy producer prices, led by sharply falling crude petroleum prices, have fallen 15 percent through the third quarter of 1997 relative to the fourth quarter of 1996. In 1996, the Federal Reserve Board real trade weighted dollar index rose 6 percent and thus far in 1997 has risen 11 percent. The strong value of the dollar is the primary factor in the overall fall in import prices of over 3 percent in the first half of 1997. The fall in import prices is also constraining the ability of U.S. manufacturers that face significant foreign competition to raise prices.

These favorable specific price developments are not expected to continue into 1998 and 1999. Benefit costs are expected to accelerate as health care costs move more in line with wage costs. As growth in developed countries outside the U.S. picks up in 1998 and 1999, energy prices should pick up. The value of the dollar is expected to gradually weaken in the second half of 1998 and 1999. A weaker dollar is expected as economic growth and asset returns gradually increase in developed countries outside the U.S. and large U.S. trade deficits persist.

Worker Concerns Over Job Security Should Lessen and put Upward Pressure on Wages In 1998 and 1999

Although the unemployment rate has fallen below 5.0 percent in recent months, other measures of labor market tightness involving job prospects and job search time fail to indicate as much job tightness as suggested by the unemployment rate and average hours worked data. The perceived continued difficulties of unemployed workers in finding new employment has been a factor in moderating wage increases despite a low unemployment rate and a long average workweek. The employment cost survey indicated wages and salaries increased 3.4 percent in 1996 and at a 3.6 percent annualized rate in the first half of 1997.

The continued relatively long duration of average time spent unemployed and the continued relatively high levels of job layoffs, given the low level of the unemployment rate, have lowered worker job security. Unemployment data indicates that the duration of unemployment for the unemployed remains relatively high and that job losses remain the dominant source of unemployment. Since the beginning of the current expansion in the spring of 1991, the duration of unemployment for those who are unemployed has actually increased. Normally, the duration of unemployment for the unemployed falls in an economic expansion. Further evidence of continued worker uncertainty is that roughly 45 percent of those unemployed are unemployed because of losing their previous job.

Worker uncertainty and its inhibiting impact on wage gains should decline in 1998 and 1999. A slower pace of corporate restructuring, the continuation of tight labor market conditions, as well as moderate gains in labor productivity, strong corporate balance sheets, and moderate increases in corporate profits in 1998 and 1999 point toward a modest to moderate acceleration in the rate of wage gains.

Recent Trend of Higher Productivity Growth Should Continue into 1998 and 1999

Productivity has rebounded sharply in recent quarters. Over the 1992 through 1995 period, nonfarm business productivity grew at an annual rate of only 0.2 percent a year. Since the end of 1995 through the second quarter of 1997, nonfarm productivity has grown at a rate of 1.5 percent. The stronger productivity numbers for 1996 and 1997 are the result of strong business investment (since 1993) that has increased the amount and quality of capital available per worker. Gradually improving worker skills that have allowed workers to better utilize improvements in capital and technology are also a factor in recent productivity gains. Increased domestic and foreign competition have also boosted productivity in recent years and should continue to boost productivity in 1998 and 1999.

Demand Side Factors Point To Slower Growth in 1998 and 1999 As Well

Although the recovery is currently in its seventh year, the economy has failed to generate the sectoral imbalances that turn a mature but slowing economic recovery into a recession. Inflation has remained low, thus reducing economic uncertainty and promoting relatively low real long term interest rates. Consumers are not currently overspending relative to their income, confidence levels, or balance sheets. Corporate balance sheets have improved substantially in recent years. Improved corporate balance sheets are allowing firms to raise more and less expensive capital. The banking system remains liquid, highly profitable, and desires to expand lending, especially in the business loan area.

Despite the lack of major sectoral imbalances, growth in aggregate demand should slow in 1998 and 1999. Business investment both in terms of fixed capital and inventory should slow in 1998 and 1999. Strong business investment since 1993 has reduced the capacity utilization rate in manufacturing by 1.5 percent since early 1995. Lower capacity utilization rates have resulted in a smaller gap between the actual and desired capital stock, which should slow the pace of business fixed investment. Very lean inventories relative to sales entering 1997 have encouraged business firms to increase inventories by over $70 billion per quarter in the first half of 1997. As inventories move closer to desired levels relative to current sales levels and growth in final demand slows in 1998 and 1999, growth in inventories should slow significantly.

Growth in consumer spending should slow in 1998 and 1999 as consumers raise their savings rate somewhat above the 4.0 percent level of the first half of 1997. The savings rate has been held down in the first half of 1997 by record levels of consumer confidence, strong gains in household wealth from the strong stock market, and strong growth in household durable demand resulting from the robust growth in residential investment in 1996 and 1997. The savings rate is expected to increase modestly or possible moderately in 1998 and 1999. Among the factors expected to raise the savings rate include slightly lower consumer confidence, slower gains in household financial wealth (resulting primarily from much slower gains in equity prices), continued tightening of consumer lending standards by commercial banks, higher interest rates, and reduced pent-up demand for consumer durables.

Real government spending is expected to continue its trend of very slow growth in 1998 and 1999. Combined real federal and state and local spending grew 0.5 percent in 1996 and 0.7 percent in the first half of 1997. Real federal government spending is expected to decline at an annual rate of 1.1 percent in 1998 and 1999. State and local spending is expected to rise at slightly above 2 percent rate in real terms in 1998 and 1999.

Federal Reserve policy is expected to raise the target for the federal funds rate to 6 percent by late spring of 1998. Federal Reserve pronouncements have showed continued concern over tight labor market conditions. As the pace of inflation accelerates slightly and economic growth remains strong in the second half of 1997, the forecast assumes the Federal Reserve reacts quickly to raise the federal funds rate. Inflation as measured by the GDP deflator is expected to average 2.6 percent in the second half of 1998 and 2.7 percent in 1999.

The increase in the federal funds rate and slightly higher inflation is expected to push the average ten year Treasury bond rate to 6.7 percent by the second half of 1998 and 1999. Higher short and long-term interest rates can be expected to raise required returns on equity instruments, thus further slowing the demand for funds by business firms. Given the substantial lags between a tightening of monetary policy and real economic growth, the impacts of higher long-term interest rates are expected to be felt more in 1999 than 1998.

Little Improvement In Net Exports Expected in 1998 or 1999

The real trade deficit, as measured by net exports widened by over $30 billion in the first half of 1997. U .S. exports will benefit from expected stronger growth in developed countries outside of the U.S. in 1998 and 1999 relative to 1997. Slower expected growth in U.S. inventories in 1998 and 1999 is a positive factor in slowing expected growth of U.S. imports. However, the positive impacts of stronger growth in foreign developed countries and slower U.S. inventory accumulation on net exports will be offset by continued relatively strong U.S. growth and the lagged effects of the large rise in the real value of the dollar since late 1995. The value of the dollar is expected to slowly decline over the latter half of 1998 and 1999 as real growth and expected asset returns gradually increase in other developed countries. Persistent large U.S. trade deficits will put additional downward pressure on the dollar by reducing the willingness of foreigners to hold additional dollar denominated assets.

The Long-Term Economic Outlook: Is This the Era of Diminishing Resources?

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Introduction

At first look, it appears that recent macroeconomic performance has been quite good. The unemployment rate is at generation-low levels and this has been achieved with surprisingly little inflation. Interest rates remain relatively low. But judging by the performance of previous expansions, our recent performance has been about average to below-average. Table 1 contains the evidence, which shows average annual growth rates for selected economic indicators between peak years in US business cycles. (Business cycle peak dates were taken from the National Bureau of Economic Research. Data in Table 1 were calculated using annual data, not quarterly or monthly data, and so provide approximations to the exact NBER peak dates. In addition, one short cycle -- peaking in July 1980 -- was lumped into a longer cycle with a peak in 1973 and the next peak in 1981.)

Looking Backward

Table 1 shows that real GDP growth has been the lowest of any peak-to-peak period in the postwar years. However, the real rate of appreciation in stock prices has been very good in the last 6 years, and the average inflation and interest rates have been the lowest since the 1960-69 period.

The figures in Table 1 show some other remarkable features. First, the table contains some warnings for those who may have come to rely on stock-market price increases to power their retirement incomes or supplement their labor earnings. From the peak in 1969 to the peak in 1981, nominal stock prices grew about 2.2 percent a year, about 4 or 5 percentage points below the average inflation rate for the same period. This is all the more sobering because business-cycle effects are mostly filtered out by calculating increases using only the NBER peak years.

The peak-to-peak figures in Table 1 also show some interesting features of population and labor force dynamics. The effect of the Baby Boom entering the working age population is shown clearly in the 1969-73 period compared to previous and subsequent expansions. It's also interesting to note that for the 1948-96 period as a whole, while labor force participation rates added about 0.3 percent a year to the available work force, at the same time, average weekly hours slipped by 0.3 percent. For the period as a whole, there was no net change in the employment rate. In other words, labor market developments have had little -- on average -- to do with long-term economic growth. This suggests that one key variable to forecast the potential labor contribution to output is the growth in the working -age population, as opposed to how the population participates in the labor force or how successfully it is employed. (Note this is definitely not true within a cycle, nor for any cycle in particular. But it is true of the long sub-periods.)

Ten-Year Outlook: More of the Same

The outlook for the next 10 years is for average economic performance to be similar to the last 7 years. As suggested above, one of the keys to forecasting growth over the longer term is a good forecast of the growth in the working -age population. The second important key is growth in output per hour. While there is little debate about how fast the working-age population is likely to grow over the next decade, there is some disagreement among forecasters about how fast productivity will grow.

Some of that disagreement is likely due to the way that longer-term forecasters look at productivity. Most forecasters take a macro view -- productivity behavior is forecast for the nonfarm sector as a whole. Others look at productivity in various industries and then attempt to aggregate these into an overall productivity number.

The sectoral approach to productivity forecasting leads to a lower forecasted rate of growth in overall productivity than does the macro approach. Table 2 shows why. Employment shares have grown most in non-medical services -- including jobs like lawyers, consultants, private education, movies and amusements -- and medical services. As the second panel of Table 2 shows, these sectors have had negative measured productivity growth from 1973 to 1994. At the same time, those sectors with relatively rapid growth in productivity account for shrinking shares of employment. Even with relatively generous assumptions about how fast measured productivity will grow in the next 10 years, (last column of Table 2), it is hard for the economy to get to 1 percent overall productivity, let alone the 1.4 percent predicted by most forecasters (shown in the last panel of Table 1).

Forecasting productivity growth is relatively difficult, and both the macro and sectoral approaches have advantages and disadvantages. Perhaps the chief lesson to take away from Table 2 is that there a set of factors that point in the direction of continued slow measured productivity growth. This tends to raise the probability that we will observe continued slow growth in the future, rather than a productivity rebound, as some are projecting.

The productivity forecast is clouded by many measurement issues, some of which have been brought to the fore by the recent investigation into whether the Consumer Price Index overstates inflation. If consumer price increases have been overstated, then "real" purchases in these sectors have been understated, which implies that "real" production has been understated. If we have accurately counted the number of hours worked in the sector, then the understatement of output implies an understatement of productivity.

The problem of measuring output is especially difficult in the services sectors, which account for a large portion of employment. For many of these sectors, there is virtually no data available on the "quantity" of services provided. For sectors like the medical services sector, while you can easily count the number of doctor or hospital visits and thus obtain a quantity index, it is apparent to even casual observers that a lot of quality change has taken place. Quality change obviously needs to be accounted for if we are to measure productivity well. Some estimates suggest that productivity growth in the medical services sector may be understated by several percentage points a year!

These thoughts put us in a Catch-22. We may believe that true productivity growth for the next 10 years will be close to or even higher than the 1.4 percent annual rate predicted by many analysts. However, based on the figures we have, it appears 1.4 percent will be hard to achieve. The forecast contained in the Inforum column of Table 1 is a forecast based on numbers that we have, even though we believe that they substantially understate the actual rate of productivity growth. At the moment, we simply don't have enough information to do otherwise.

More Than Ten Years After

The outlook after about 10 years is not especially good. Despite recent legislation to balance the federal budget by 2002, the projected changes in the age structure of the population, (Table 3) combined with the structure of federal entitlement programs (Medicare and OASDI in particular) suggest very large federal deficits (Graph 1).

Without steps to keep the federal deficit from ballooning when the Baby Boomers reach federal program retirement age (2011), the share of national income devoted to savings will drop dramatically. According to the standard economic growth model, this will lead to increasingly lower rates of capital formation, increasingly higher interest rates, and increasingly lower labor productivity growth.

The projected deficit problem is so severe that reasonable economic simulation models cannot meaningfully calculate the economic outlook -- the models break -- unless taxes are raised, benefits are reduced, or other federal outlays are reduced. The tax increases projected to lead to sensible model results are large. Pay-as-you go financing -- raising taxes to match spending increases -- leads to a doubling of payroll tax rates to keep the federal budget balanced (Monaco and Phelps, mimeo 1997).

The expectation of rising federal deficits and their actual onset will probably bring on a host of "structural" changes in the economy. When we think about what these adjustments might be, we round up the two usual suspects: higher taxes and reductions in benefits (including raising the retirement age). In closing, however, here is some speculation about other ways the economy will adjust :

Surprisingly large increases in labor force participation among the 65.

Encouragement of immigration.

Encouragement of fertility .

Changing the entitlement nature of Medicare and Social Security. At some point, government payments will be linked to "need" rather than age.

Analysts will adjust too. Over the next several years, we will likely redefine service price and output measures. This will reduce the severity of the measured productivity slowdown after 1973, and provides a "truer" picture of real economic well-being.

Table 1
Economic Performance and Forecasts, 1948-2006

	History									Forecasts			
										Inforum	CBO	SPF	Blue Chip
	1948-96	1948-53	1953-57	1957-60	1960-69	1969-73	1973-81	1981-90	1990-96	1997-06			
	Average annual growth												
Working Age Population	1.4	0.8	1.2	1.4	1.5	2.3	1.8	1.2	1.0	1.0			
+ Participation rate	0.3	0.0	0.3	-0.1	0.1	0.3	0.6	0.5	0.1	0.3			
= Labor force	1.7	0.8	1.5	1.3	1.6	2.6	2.4	1.6	1.0	1.3			
+ Employment rate	0.0	0.2	-0.4	-0.4	0.2	-0.4	-0.4	0.2	0.0	-0.1			
= Employment	1.6	1.0	1.1	0.9	1.9	2.2	2.1	1.9	1.1	1.2			
Employment (nonfarm business)	1.7	1.7	0.8	0.3	2.2	1.9	2.1	2.0	1.3	1.2			
+ Average weekly hours	-0.3	-0.2	-0.3	-0.1	-0.4	-0.6	-0.7	0.0	0.1	-0.1			
= Total hours	1.4	1.4	0.6	0.2	1.8	1.3	1.4	2.0	1.3	1.0			
+ Output per hour	2.0	3.4	1.9	2.5	3.0	3.0	0.9	1.1	1.0	0.8		1.4	
= Total output	3.4	4.7	2.5	2.7	4.8	4.3	2.3	3.1	2.3	1.8			
Real GDP	3.2	4.6	2.5	2.8	4.5	3.6	2.3	2.9	2.0	1.8	2.4	2.4	2.4
Inflation and Prices													
Consumer Price Index	3.9	2.1	1.2	1.7	2.4	4.8	9.0	4.0	3.0	3.2	3.0	2.9	3.0
GDP Implicit Price Deflator	3.8	2.2	2.4	1.6	2.4	5.0	7.8	3.9	2.7	3.1	2.6		2.6
S & P 500	7.8	9.3	14.6	7.7	6.2	2.3	2.2	10.7	11.6			9.0	
	Average of variables during business cycles												
Interest rates, in percentages													
3-month Treasury bill	5.1	1.4	2.1	2.9	4.0	5.7	8.2	8.5	4.9	5.3	4.6	4.7	5.2
10-year Treasury bond	6.4	2.4	3.0	3.9	4.7	6.6	9.0	10.3	7.1	6.4	5.8	6.4	6.4
Civilian unemployment rate, %	5.7	4.0	4.3	5.5	4.8	5.0	6.7	7.1	6.3	5.4	5.7		5.5

Sources: Inforum, May 1997 Forecast, FRB of Philadelphia, *Survey of Professional Forecasters* (SPF), First Quarter 1997
Congressional Budget Office, *The Economic and Budget Outlook, Update* September 1997, *Blue Chip Economic Indicators*, March and September 1997

Table 2
Industry Productivity and Employment Shares

	Shares of total jobs		Productivity Growth	
	1973	1994	1973-94	1997-2006
Civilian jobs	100.0	100.0		
Private sector jobs	83.9	84.2	1.0	0.8
Agriculture, forestry, fishery	3.9	2.7	2.4	1.7
Mining	0.7	0.5	0.0	1.3
Construction	5.6	5.0	0.1	0.2
Nondurables manufacturing	9.4	6.2	1.9	2.1
Durables manufacturing	12.6	8.4	1.7	2.0
Transportation	3.4	3.4	1.4	1.3
Utilities	2.3	1.8	2.3	3.4
Trade	20.7	22.0	1.2	1.3
Finance, insurance, real estate	4.9	5.9	0.3	0.9
Services, nonmedical	11.0	20.9	-1.8	0.6
Medical services	3.1	7.5	-2.0	0.3
Civilian Government	14.8	15.8		

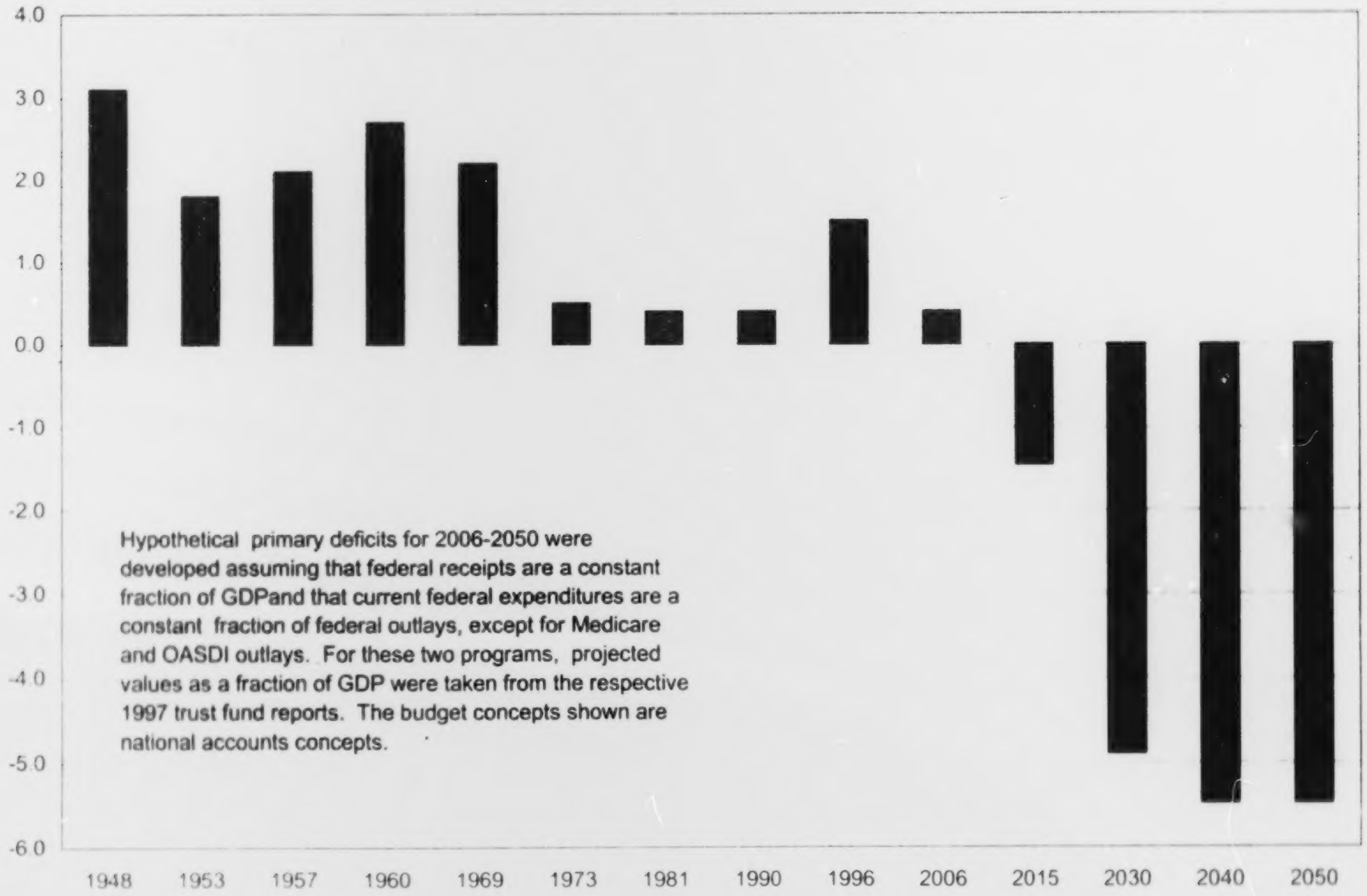
Source: Inforum data files. Employment shares will not add to 100 because civilian jobs includes domestic servants, which are not included in any listed sector.

Table 3
Population Projections 1996-2050

	1996	2006	2015	2030	2040	2050
Population Concepts	millions of people					
Total	265.7	287.6	304.8	327.2	336.2	342.7
Working Age (BLS definition)	207.6	228.6	245.5	266.2	274.6	280.3
Aged 20-64	155.4	172.0	181.0	180.9	185.8	189.7
Aged 65+	33.9	36.1	44.0	64.3	67.8	69.3
Ratio, People aged 20-64 to 65+	4.6	4.8	4.1	2.8	2.7	2.7
	annual growth from previously displayed year, percent					
Total Population		0.8	0.6	0.5	0.3	0.2
Working Age (BLS definition)		1.0	0.8	0.5	0.3	0.2
Population, 20-64		1.0	0.6	0.0	0.3	0.2

Source: Inforum population forecast, November 1996

Primary Surplus as a Share of GDP, selected years



Hypothetical primary deficits for 2006-2050 were developed assuming that federal receipts are a constant fraction of GDPand that current federal expenditures are a constant fraction of federal outlays, except for Medicare and OASDI outlays. For these two programs, projected values as a fraction of GDP were taken from the respective 1997 trust fund reports. The budget concepts shown are national accounts concepts.

INDUSTRY MODELING AT THE BUREAU OF LABOR STATISTICS

Chair: Norman C. Saunders
Bureau of Labor Statistics, U.S. Department of Labor

A Model of Detailed Industry Labor Demand,
James C. Franklin, Bureau of Labor Statistics, U.S. Department of Labor

A Model of Detailed Personal Consumption Expenditures,
Janet E. Pfleeger, Bureau of Labor Statistics, U.S. Department of Labor

A Commodity-Specific Model for Projecting Import Demand,
Betty W. Su, Bureau of Labor Statistics, U.S. Department of Labor

A Model of New Nonresidential Equipment Investment,
Jay M. Berman, Bureau of Labor Statistics, U.S. Department of Labor

A MODEL OF DETAILED INDUSTRY LABOR DEMAND

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Introduction

Within the Bureau of Labor Statistics (BLS), the Office of Employment Projections (OEP) is charged with developing long term projections of employment by industry and occupation. These projections are developed to facilitate understanding of current and future labor market conditions and are disseminated for use in career guidance and public policy planning that is related to employment issues. A system of several component models is used by OEP to develop these projections. This paper presents the industry level labor model. The labor model and its sub-components are defined and the integration of the labor model with the larger OEP projections system is described.

The labor model

The labor model is actually a group of equations and identities which are solved independently. The main component of the labor model is the equation that estimates the demand for wage and salary hours. It is derived from a constant elasticity of substitution (CES) production function. The remaining equations and identities are necessitated by the availability of data and the relationship of the labor model to the other components of the OEP projections system. The labor equation which estimates demand for wage and salary hours is based on a theoretical economic structure while the other estimated equations are time and other variable extrapolations.

The CES derived labor equation

The demand for wage and salary hours for each industry is estimated using the first order conditions of a CES production function modified to include a time variable. The time variable captures disembodied technical change or shifts in the production function that do not affect the labor and capital ratio. These shifts of the production indicate increased efficiencies in the use of the capital and labor inputs.

The basic form of the production function is:

Equation 1

$$Y = f(t,L,K)$$

where:

Y	real output
L	labor
K	capital stock
t	time

The model assumes perfect competition and profit maximization so that:

> both factors are indispensable in the production of output — $f(0,K)=f(0,L)=0$
>
> both marginal products are nonnegative — $\partial f/\partial L => 0$, $\partial f/\partial K => 0$
>
> and the marginal products are equal to the real factor prices — $\partial f/\partial L = w/p$, $\partial f/\partial K = r/p$

where 'w,r,p' are the nominal prices for labor, capital and output.

It is also assumed the rate of growth of disembodied technical change is proportionate and constant.

The functional form of the labor demand model is:

Equation 2

$$Y = A e^{mt}\left[\delta L^{-\beta} + (1-\delta)K^{-\beta}\right]^{-1/\beta}$$

where

A	is a scale parameter, $A > 0$;
δ	is a distribution parameter, $0 < \delta < 1$
β	is a substitution parameter, $\beta \geq -1$
Y	is real output
L	is labor, measured as annual wage and salary hours in millions
K	is the capital stock
m	is disembodied technical change growth rate
t	is time, measured as the year

The marginal product of labor can be written:

$$\partial Y / \partial L = A' e^{gt} \left(\frac{Y}{L}\right)^{1+\beta}$$

where $A' = \delta A^{-\beta}$ and $g = -\beta m$.

The perfect competition and profit maximization assumptions require that:

$$A' e^{gt}\left(\frac{Y}{L}\right)^{1+\beta} = \frac{w}{p}$$

where

w	is nominal wages
p	is the output price

Solving for labor productivity:

$$\frac{Y}{L} = \left(A'e^{gt}\right)^{\frac{-1}{\beta+1}}\left(\frac{w}{p}\right)^{\frac{1}{\beta+1}}$$

taking logs:

$$\ln(Y) - \ln(L) = \frac{1}{\beta+1}\ln\left(\frac{w}{p}\right) - \frac{1}{\beta+1}\ln(A') - \frac{g}{\beta+1}t$$

then solving for labor:

$$\ln(L) = \frac{1}{\beta+1}\ln(A') + \frac{g}{\beta+1}t + \ln(Y) - \frac{1}{\beta+1}\ln\left(\frac{w}{p}\right)$$

results in the final basic form of the equation. The estimated form of the equation is:

Equation 3

$$\ln L = a_0 + a_1 t + a_2 \ln Y + a_3 \ln\left(\frac{w}{p}\right)$$

Other equations and identities

Equation 3 requires estimated data for real output, nominal wage, and output price by industry for a solution. The output level is supplied by the input-output system as an exogenous variable. The industry price and wage data are estimated using projected variables from the macro-economic model which produces the aggregate projections in the OEP projection system.

Given an industry's output, wage and output price, equation 3 will solve for the required wage and salary hours. The end product of OEP's projection system, however, includes the employment level by industry for wage and salary, and self-employed and unpaid family. The solution for equation 3 must be converted to an employment level for wage and salary using an extrapolated estimate for each industry's average weekly hours. The number of self-employed and unpaid family for each industry and their hours must also be estimated.

Industry average hourly wage estimation

The nominal average hourly wage for each industry is estimated in a two step process. First, an all industry nominal average hourly wage is estimated as a function of the BLS series employment cost index. The employment cost index is estimated by the macro model for the projection period. Second, the nominal average hourly wage for each industry is estimated as a function of the all industry average hourly wage. The following equations are used to estimate the industry average hourly wage.

Equation 4

$$TotAHW = a_0 + a_1 ECIWS + a_2 ur$$

Equation 5

$$AHW_i = a_0 + a_1 TotAHW : a_0 = 0$$

where

$TotAHW$	is the total average hourly wage
$ECIWS$	is the employment compensation index for wage and salary
AHW_i	is the average hourly wage for industry i
ur	is the aggregate unemployment rate
a_i	are constants/coefficients

Industry price index estimation

The price index for each industry is estimated with the following equation:

Equation 6

$$\ln(p_i) = a_0 + a_1 \ln(P)$$

where:

p_i	is the price chain weighted index for each industry
P	is the GDP chain weighted price index
a_i	are constants/coefficients

Industry average weekly hours estimation

Average weekly hours for both wage and salary and self-employed and unpaid family are estimated as a function of the year and the aggregate unemployment rate.

Equation 7

$$AWH_i = a_0 + a_1 t + a_3 ur$$

where

t	is time measured as the year
AWH_i	are average weekly hours for each industry
ur	is the aggregate unemployment rate
a_n	are constants/coefficients

Industry self-employed and unpaid family estimation

The number of self-employed and unpaid family for each industry was derived by using an estimate of the ratio of the self-employed and unpaid family to total employment to derive the level of total employment for each industry from the level of wage and salary, and then subtracting the wage and salary from the total employment. The logit transformation of the self-employed and unpaid family workers ratio to total employment was estimated as a function of the year and the aggregate unemployment rate using the following equation.

Equation 8

$$\ln\left(\frac{SR}{1-SR}\right) = a_0 + a_1 t + a_3 ur$$

where

SR	is the ratio (self-employed and unpaid family workers/total employment)
t	is time, measured as the year
ur	is the aggregate unemployment rate
a_i	are constants/coefficients

Employment, hours and average weekly hours identity

Employment, measured in thousands, for wage and salary, and self-employed and unpaid family, is related to the annual hours measured in millions and the average weekly hours by the following identity.

Equation 9

$$E_i = \left({}^{L_i}\!/_{AWH_i}\right)\frac{1}{.052}$$

where

E_i	employment level in thousands
L_i	annual hours, measured in millions
AWH_i	average weekly hours

Projections of labor demand

The initial projections of industry employment are developed according to the following procedure implemented for each industry.

1. The industry demands for wage and salary hours in millions are projected.
2. Wage and salary annual average weekly wage and salary hours are estimated.
3. The industry levels of wage and salary jobs in thousands are then derived from the estimation of hours and average weekly hours.
4. The ratio of self-employed and unpaid family workers to total employment is extrapolated.
5. The extrapolated ratio is then used to derive the level of self-employed and unpaid family workers from the number of wage and salary jobs.
6. Self-employed and unpaid family average weekly hours are estimated.
7. The hours for self-employed and unpaid family workers are then derived from their estimated average weekly hours and the estimated number of self-employed and unpaid family workers.
8. Finally, wage and salary, and self-employed and unpaid family worker employment and hours are combined to calculate a total level of employment and hours for each industry.

Data sources

The output measures follow the definitions and conventions used by the Bureau of Economic Analysis (BEA) in its input-output tables, published every five years. These industry output measures are based on producer's value and include both primary and secondary products and services. The main data sources for compiling the output time series for manufacturing industries are the Census and Annual Survey of Manufactures. Data sources for nonmanufacturing industries are more varied. They include the Service Annual Survey, National Income and Product Accounts (NIPA) data on new construction and personal consumption expenditures, IRS data on business receipts, and many other sources. The constant dollar industry output estimates for the most recent years are based on BLS employment data and trend projections of productivity. The output series are benchmarked to the BEA input-output tables for 1987 which was adjusted by BLS to reflect the 1987

SIC revision, National Income and Product Account revisions, and to place the tables more consistently on an SIC basis.

The annual price data are developed in a manner so as to conform to BEA's national income and product accounts. For manufacturing, they are based on industry sector price index data collected by BLS. Nonmanufacturing prices use a variety of different sources, in many instance the BLS consumer price index data. In industries where such underlying price data have not yet been developed, imputations of price change are made by the BEA from other data series.

The employment data come from the BLS current employment statistics (the establishment data series for wage and salary jobs and average weekly hours), the current population survey (for self-employed and unpaid family worker jobs, agricultural employment except for agricultural services, and private household employment), ES202 Employment and Wages data collected for the unemployment insurance program (agricultural services and total wages paid), and some unpublished data sources within the Bureau. Average hourly wages were calculated using the ES202 wage data and the annual hours estimate developed from the current employment statistics data for each industry, except for the government sector.

All data series are developed on an annual basis. The beginning and ending years differ between the data series. The industry output and price series begins in 1972; the employment series varies by industry, the earliest year being 1958; the wage data series begins in 1975. The industry output and price data end in 1996, although for most industries the 1995 and 1996 data points are extrapolations. The employment data also ends in 1996. The wage data ends in 1994. The regression estimates, limited by common years, are based on data from 1975 through 1994.

Regression and results

All regression estimates for the equations of the labor model are estimated using ordinary least squares. With the exception of the agricultural and public sectors, employment levels and hours are estimated using the equations and procedures previously outlined.

The output for the public sectors is comprised of compensation, making the wage variable in equation 3 redundant. Consequently, the wage variable is dropped from the regression equation for the public sector.

The wage variable for the agricultural sectors is also dropped because the wage data from the ES202 covered employment and wages program is not complete for the agricultural sectors. Not all employment in the agricultural sectors is covered by the unemployment insurance program.

The sectoring plan which OEP uses to define the industries consists of 185 sectors, 8 of which are special accounting industries that have no associated employment. Sectors 170 through 179 are government industries and sectors 1 through 3 are agricultural industries. That leaves 164 industries for which employment is estimated using the fully expressed labor equation. The discussion of the regression results will focus on these 164 industries. The regression statistics for all industries are listed in table 1.

All of the industries which are estimated using the full labor equation have very high r-squares and significance levels as given by the F-test. However, the three explanatory variables (year, real output, real wage) are significant in only 28 out of 164 industries (see figure 1). This is only seventeen percent of the industries. The year variable is included to capture possible shifts in the production function that underlie the regression equation and is not strictly an economic variable. If it is ignored and only the economic variables (real output and real wage) are considered, then only 52 of the 164 industries, or 32 percent, have both variables significant.

Conclusion

These results suggest a strong multicollinearity problem. Given the nature of the data set, however, this is not unexpected. These are strongly correlated

Figure 1	Number of industries			Percent of industries		
	Correct Sign	Significant @ .05	Correct Sign and significant @ .05	Correct Sign	Significant @ .05	Correct sign and significant @ .05
Year	NA	94	NA	NA	57%	NA
Output	150	117	114	91%	71%	70%
Real wage	129	74	69	79%	45%	42%
Output and real wage	118	52	47	72%	32%	29%
Year, output and real wage	NA	28	23	NA	17%	14%

time series data. The usual recourse is to add or drop variables, or to enrich the data by adding data points. Since the labor equation is a formally structured model, adding or dropping variables has limited appeal. The wage variable is dropped for those sectors for which the available data does not conform to the demands of the model. Otherwise the preference is to leave the model as specified. As for adding data points, all the available data in the time series is being used. The final option is to do nothing about the multicollinearity problem, and this is warranted for several reasons. First, the labor model is a formal model based on strong economic principals. Second, the multicollinearity does not invalidate the significance of the regression equations. It does make analysis of the explanatory power of the individual variables problematic. Since the purpose of the labor model is projections work, the explanatory power of the variables are of lessor importance than the significance of the whole equation. And finally, the labor model in practice seems to perform well enough. Its principal purpose is to estimate an initial level of projected employment by industry. The OEP projections process is an iterative one with several points of subjective review. Consequently, the labor model is not expected to produce a final and publishable projection without review and adjustment. As an estimator of the initial industry level employment projections and an adjunct to subjective analysis it has proved useful.

Table 1 Labor Demand Estimated Equations

Industry	SIC	Intercept	Year	ln(Output)	ln(W/P)			
		a0	a1	a2	a3	R-squared	F-value	Degrees Freedom
1 Agricultural production	01,02	12.7148	-0.0021	-0.0701		0.99997	286150.7	17.0
		(2.2403)	(-0.4910)	(-0.2590)				
2 Agricultural services	07	-75.3221	0.0408	0.1394		0.99997	230284.7	14.0
		(-8.3368)	(8.4838)	(2.3402)				
3 Forestry, fishing, hunting, & trapping	08,09	-96.1361	0.0538	-0.6912		0.99906	9046.8	17.0
		(-3.7002)	(3.5270)	(-1.2926)				
4 Metal mining	10	37.1368	-0.0166	0.2625	-0.6080	0.99695	5060.8	16.0
		(1.2590)	(-1.0780)	(1.4740)	(-1.9766)			
5 Coal mining	12	54.6714	-0.0310	1.4666	-0.7069	0.99994	83912.6	16.0
		(1.8196)	(-1.9435)	(5.9270)	(-2.8177)			
6 Crude petroleum, natural gas, and gas liquids	131,132	-110.8263	0.0410	3.1841	-0.2901	0.99974	20795.4	16.0
		(-3.2439)	(4.0496)	(2.3523)	(-2.8014)			
7 Oil and gas field services	138	-2.5254	-0.0007	1.0129	0.0489	0.99994	86943.4	16.0
		(-0.3643)	(-0.1843)	(19.7583)	(0.4116)			
8 Nonmetallic minerals, except fuels	14	4.6726	-0.0007	0.3376	-0.4284	0.99999	535946.6	16.0
		(1.3814)	(-0.3504)	(6.8331)	(-4.5567)			
9 Construction	15,16,17	-16.8201	0.0091	0.6474	-0.3120	0.99998	346450.9	16.0
		(-4.9143)	(4.1101)	(4.6763)	(-1.1986)			
10 Logging	241	-0.5772	0.0023	0.1187	0.0111	0.99990	51972.9	16.0
		(-0.1003)	(0.6886)	(0.6714)	(0.0977)			
11 Sawmills and planing mills	242	35.1376	-0.0182	0.7230	-0.0528	0.99996	119068.3	16.0
		(6.8083)	(-5.8037)	(5.4314)	(-0.5793)			
12 Millwork, plywood, and structural members	243	3.0396	-0.0029	0.9981	-0.0075	0.99997	210156.7	16.0
		(0.6944)	(-1.1479)	(11.3869)	(-0.0800)			
13 Wood containers and misc. wood products	244,249	11.7050	-0.0047	0.4265	-0.3753	0.99997	156381.0	16.0
		(1.1883)	(-0.7971)	(2.3697)	(-2.2023)			
14 Wood buildings and mobile homes	245	8.7249	-0.0066	0.9817	0.2666	0.99994	82696.1	16.0
		(1.5855)	(-2.0638)	(9.0827)	(1.0246)			
15 Household furniture	251	30.3432	-0.0172	0.9752	0.2580	0.99999	590363.4	16.0
		(2.7894)	(-2.6759)	(8.3807)	(0.5673)			
16 Partitions and fixtures	254	-34.8698	0.0198	0.3727	-1.1149	0.99993	77975.5	16.0
		(-2.3003)	(2.1182)	(1.3976)	(-1.6905)			
17 Office and misc. furniture and fixtures	252,253,259	40.8446	-0.0227	0.8776	0.5914	0.99997	160969.8	16.0
		(1.9388)	(-1.9317)	(6.4158)	(1.1996)			
18 Glass and glass products	321,322,323	13.4835	-0.0059	0.6196	-0.7325	0.99999	606324.4	16.0
		(2.6406)	(-1.9814)	(7.5605)	(-3.8610)			
19 Hydraulic cement	324	40.6136	-0.0173	0.0182	-0.9418	0.99990	53135.0	16.0
		(4.9198)	(-3.9987)	(0.1256)	(-4.9914)			
20 Stone, clay, and misc. mineral products	325,326,328,329	9.7971	-0.0053	0.7770	-0.4061	0.99999	705578.3	16.0
		(2.5965)	(-2.5163)	(12.9180)	(-2.9334)			
21 Concrete, gypsum, & plaster products	327	-0.3012	0.0008	0.5956	-0.4517	0.99998	217532.0	16.0
		(-0.0609)	(0.2778)	(7.0857)	(-2.9650)			
22 Blast furnaces and basic steel products	331	89.8277	-0.0460	0.5863	0.5796	0.99995	117153.6	16.0
		(8.8577)	(-8.4737)	(8.9426)	(1.7558)			
23 Iron and steel foundries	332	24.3085	-0.0126	0.7489	-0.2196	0.99999	819425.3	16.0
		(8.8934)	(-8.2651)	(23.8522)	(-1.2233)			
24 Primary nonferrous smelting & refining	333	46.1408	-0.0240	0.6398	0.0364	0.99990	53458.9	16.0
		(8.0032)	(-8.2764)	(8.0732)	(0.4678)			
25 All other primary metals	334,339	-28.6537	0.0179	-0.1623	-0.4003	0.99984	33378.3	16.0
		(-2.5416)	(2.7972)	(-0.8061)	(-3.2116)			
26 Nonferrous rolling and drawing	335	23.1990	-0.0123	0.6483	0.1245	0.99998	213449.5	16.0
		(7.0962)	(-6.3663)	(5.6728)	(1.2037)			
27 Nonferrous foundries	336	14.9229	-0.0067	0.8493	-0.0313	0.99997	164990.4	16.0
		(2.8737)	(-2.7504)	(7.1986)	(-0.1824)			
28 Metal cans and shipping containers	341	37.8430	-0.0157	0.0153	-0.7616	0.99997	160613.1	16.0
		(4.7077)	(-3.7648)	(0.0772)	(-4.7371)			
29 Cutlery, hand tools, and hardware	342	26.0119	-0.0131	0.7143	-0.4534	0.99999	522658.8	16.0
		(7.2716)	(-6.3350)	(11.4756)	(-2.8958)			
30 Plumbing and nonelectric heating equipment	343	9.7106	-0.0050	0.7129	-0.4742	0.99997	172777.1	16.0
		(2.9698)	(-2.5484)	(6.1625)	(-1.8189)			
31 Fabricated structural metal products	344	16.5429	-0.0069	0.4581	-0.3928	0.99998	245354.0	16.0
		(1.8145)	(-1.0368)	(1.3644)	(-1.0426)			
32 Screw machine products, bolts, rivets, etc	345	-13.2581	0.0076	0.6152	-0.8465	0.99999	495508.1	16.0
		(-1.5338)	(1.5956)	(10.4756)	(-4.4222)			
33 Metal forgings and stampings	346	22.1390	-0.0117	0.7769	-0.2616	0.99998	349293.3	16.0
		(2.7864)	(-2.6924)	(11.7306)	(-1.2117)			
34 Metal coating, engraving, and allied services	347	-16.6322	0.0096	0.5181	-0.7023	0.99998	268597.4	16.0
		(-1.7196)	(1.7857)	(6.2469)	(-2.9645)			
35 Ordnance and ammunition	348	-13.4128	0.0069	0.6667	-0.4463	0.99987	39946.6	16.0
		(-0.8062)	(0.8192)	(5.6915)	(-1.6691)			
36 Miscellaneous fabricated metal products	349	2.5217	-0.0005	0.6179	-0.6459	0.99999	561871.2	16.0
		(0.7064)	(-0.2182)	(5.5938)	(-3.5291)			
37 Engines and turbines	351	24.5893	-0.0110	0.4620	-0.7000	0.99993	79274.8	16.0

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Table 1 Labor Demand Estimated Equations

Industry	SIC	Intercept	Year	ln(Output)	ln(W/P)			
		a0	a1	a2	a3	R-squared	F-value	Degrees Freedom
		(3.4941)	(-2.7897)	(4.3902)	(-1.9762)			
38 Farm and garden machinery and equipment	352	30.1271	-0.0154	0.7498	-0.5041	0.99998	265331.7	16.0
		(10.2175)	(-10.4033)	(19.8783)	(-1.4418)			
39 Construction and related machinery	353	18.0521	-0.0083	0.6235	-0.6378	0.99997	152452.3	16.0
		(3.0595)	(-2.7063)	(5.7491)	(-1.5454)			
40 Metalworking machinery and equipment	354	-6.3469	0.0053	0.4800	-0.9734	1.00000	1370974.2	16.0
		(-2.6972)	(3.7778)	(14.2698)	(-7.0569)			
41 Special industry machinery	355	-1.5807	0.0034	0.4683	-1.4401	0.99998	286131.1	16.0
		(-0.3519)	(1.3828)	(7.2708)	(-7.5570)			
42 General industrial machinery and equipment	356	8.7713	-0.0033	0.5447	-0.6119	0.99999	601883.0	16.0
		(2.9973)	(-1.5662)	(5.1137)	(-2.7269)			
43 Computer and office equipment	357	220.6849	-0.1109	0.6524	-0.0962	0.99992	70663.6	16.0
		(3.2124)	(-3.1967)	(8.4103)	(-0.4433)			
44 Refrigeration and service industry machinery	358	4.5149	-0.0024	0.6883	-0.3050	0.99999	960150.9	16.0
		(0.8244)	(-0.7861)	(15.4587)	(-2.3351)			
45 Industrial machinery, nec.	359	1.7924	0.0002	0.6291	-0.8069	0.99997	213046.3	16.0
		(0.1617)	(0.0313)	(3.9956)	(-2.3721)			
46 Electric distribution equipment	361	17.0204	-0.0065	0.3021	-0.6108	0.99994	82999.7	16.0
		(2.0538)	(-1.3185)	(1.7091)	(-1.5392)			
47 Electrical industrial apparatus	362	33.1692	-0.0150	0.4480	-0.6760	0.99997	166479.2	16.0
		(4.0081)	(-2.9362)	(2.7052)	(-2.5280)			
48 Household appliances	363	56.6495	-0.0297	0.8720	-0.2049	0.99999	429035.8	16.0
		(5.0723)	(-4.9726)	(11.4304)	(-1.0513)			
49 Electric lighting and wiring equipment	364	13.3100	-0.0059	0.6146	-0.6638	0.99999	589753.6	16.0
		(2.9642)	(-2.2163)	(8.6669)	(-4.2162)			
50 Household audio and video equipment	365	-104.9495	0.0562	0.1473	-1.1295	0.99993	74062.4	16.0
		(-3.2697)	(3.4217)	(1.7625)	(-4.8905)			
51 Communications equipment	366	185.4655	-0.0957	0.7255	1.3010	0.99991	56493.1	16.0
		(3.2633)	(-3.2514)	(3.8486)	(1.9664)			
52 Electronic components and accessories	367	169.7680	-0.0874	0.8699	0.6589	0.99975	21313.9	16.0
		(1.0905)	(-1.0811)	(3.0908)	(0.5338)			
53 Miscellaneous electrical equipment	369	3.4019	-0.0001	0.2814	-0.0347	0.99987	41335.6	16.0
		(0.1418)	(-0.0106)	(1.6623)	(-0.1038)			
54 Motor vehicles and equipment	371	20.6759	-0.0104	0.6605	-0.2386	0.99999	522950.5	16.0
		(3.6438)	(-3.3351)	(13.8544)	(-0.8641)			
55 Aerospace	372,376	24.1134	-0.0141	1.0367	-0.2146	0.99997	211227.1	16.0
		(2.4230)	(-2.4887)	(12.4714)	(-0.8606)			
56 Ship and boat building and repairing	373	9.0749	-0.0055	0.9281	-0.4252	0.99997	201960.0	16.0
		(1.9121)	(-2.9439)	(6.3613)	(-1.7584)			
57 Railroad equipment	374	37.8813	-0.0189	0.5084	-0.1376	0.99977	22963.2	16.0
		(5.1863)	(-5.4801)	(7.2734)	(-0.2494)			
58 Miscellaneous transportation equipment	375,379	21.4946	-0.0111	0.7046	-0.3524	0.99981	28425.1	16.0
		(1.2825)	(-1.2488)	(4.9452)	(-1.1417)			
59 Search and navigation equipment	381	55.6110	-0.0267	0.4571	-0.3026	0.99982	29035.3	16.0
		(0.7839)	(-0.7100)	(6.7812)	(-0.2242)			
60 Measuring and controlling devices	382	46.8752	-0.0254	1.0243	-0.2028	0.99996	122780.9	16.0
		(1.4045)	(-1.3837)	(4.9001)	(-0.4484)			
61 Medical equipment, instruments, and supplies	384	-75.7911	0.0411	0.2952	-1.0348	0.99998	328699.0	16.0
		(-3.4518)	(3.4577)	(1.8570)	(-6.1700)			
62 Ophthalmic goods	385	-81.5636	0.0441	0.1523	-1.1090	0.99993	76370.7	16.0
		(-3.2356)	(3.3557)	(1.6361)	(-4.4142)			
63 Photographic equipment and supplies	386	73.4183	-0.0380	0.7579	0.0129	0.99993	72680.2	16.0
		(3.0977)	(-2.8953)	(3.4528)	(0.0504)			
64 Watches, clocks, and parts	387	36.1942	-0.0155	0.2109	-1.5830	0.99959	12869.9	16.0
		(1.0309)	(-0.8370)	(2.1213)	(-2.3908)			
65 Jewelry, silverware, and plated ware	391	13.2050	-0.0050	0.2058	-0.1862	0.99998	241141.8	16.0
		(5.5921)	(-4.3928)	(5.2940)	(-5.4335)			
66 Toys and sporting goods	394	18.6742	-0.0091	0.6063	-0.3278	0.99996	130943.4	16.0
		(0.9600)	(-0.8468)	(3.6358)	(-1.1441)			
67 Manufactured products, nec.	393,395,396,399	17.0780	-0.0078	0.5516	-0.3654	0.99998	282829.6	16.0
		(2.2939)	(-1.8434)	(5.1672)	(-1.8381)			
68 Meat products	201	-18.5559	0.0103	0.4998	-0.3670	0.99998	255594.8	16.0
		(-2.3468)	(1.9592)	(2.0944)	(-2.8314)			
69 Dairy products	202	24.7606	-0.0117	0.4652	-0.2584	0.99999	406041.2	16.0
		(3.6262)	(-3.2348)	(1.6055)	(-1.6296)			
70 Preserved fruits and vegetables	203	11.7090	-0.0075	0.9472	-0.2921	0.99998	216239.3	16.0
		(1.1121)	(-1.1611)	(4.0498)	(-1.1248)			
71 Grain mill products and fats and oils	204,207	-5.4479	0.0062	-0.0051	-0.3492	0.99998	327799.8	16.0
		(-0.3925)	(0.7076)	(-0.0147)	(-4.6814)			
72 Bakery products	205	18.2740	-0.0074	0.3617	-0.4659	1.00000	1441085.0	16.0
		(11.6330)	(-14.4365)	(3.9664)	(-5.6193)			
73 Sugar and confectionery products	206	20.9922	-0.0096	0.3382	0.0022	0.99997	185821.4	16.0
		(3.2857)	(-2.6526)	(2.1595)	(0.0166)			

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Table 1 Labor Demand Estimated Equations

Industry	SIC	Intercept	Year	ln(Output)	ln(W/P)			
		a0	a1	a2	a3	R-squared	F-value	Degrees Freedom
74 Beverages	208	36.7762	-0.0190	0.7390	-0.4329	0.99998	332382.5	16.0
		(3.1937)	(-2.8384)	(4.2325)	(-2.1913)			
75 Miscellaneous food and kindred products	209	-27.9798	0.0171	0.0594	-0.2974	0.99998	249506.7	16.0
		(-3.7184)	(3.7565)	(0.3306)	(-2.3945)			
76 Tobacco products	21	41.9786	-0.0214	0.4398	0.1491	0.99994	82396.7	16.0
		(4.1767)	(-5.3411)	(2.1602)	(1.1461)			
77 Weaving, finishing, yarn, and thread mills	221-224,226,228	34.4024	-0.0178	0.6281	-0.4270	0.99999	646051.5	16.0
		(3.3462)	(-3.1793)	(8.5248)	(-2.2433)			
78 Knitting mills	225	-19.5024	0.0119	0.3936	-0.8722	0.99997	202747.3	16.0
		(-0.8275)	(0.9612)	(3.5823)	(-1.9043)			
79 Carpets and rugs	227	-87.4170	0.0469	0.3510	-1.9117	0.99985	34682.1	16.0
		(-3.2041)	(3.2393)	(2.4253)	(-3.7866)			
80 Miscellaneous textile goods	229	26.4402	-0.0125	0.4606	-0.3711	0.99998	144757.3	16.0
		(1.9212)	(-1.7004)	(4.5923)	(-1.8877)			
81 Apparel	231-238	7.6018	-0.0011	0.3310	-1.0791	0.99999	906978.0	16.0
		(0.6360)	(-0.1672)	(3.4251)	(-3.0504)			
82 Miscellaneous fabricated textile products	239	1.5806	-0.0004	0.6350	-0.4616	0.99998	254701.0	16.0
		(0.1541)	(-0.0749)	(5.9017)	(-2.0482)			
83 Pulp, paper, and paperboard mills	261-263	27.9086	-0.0128	0.3546	0.0204	0.99999	754165.6	16.0
		(5.9606)	(-4.4186)	(3.2640)	(0.3786)			
84 Paperboard containers and boxes	265	12.0016	-0.0072	0.8521	-0.1308	0.99999	684722.5	16.0
		(4.1576)	(-3.7572)	(8.5354)	(-1.4927)			
85 Converted paper products except containers	267	1.1122	-0.0008	0.6725	-0.2015	0.99999	957280.2	16.0
		(0.1979)	(-0.2191)	(5.1541)	(-2.6425)			
86 Newspapers	271	-19.8555	0.0112	0.4267	-0.0435	1.00000	1441970.9	16.0
		(-2.1744)	(2.6566)	(9.9520)	(-0.1714)			
87 Periodicals	272	-52.6233	0.0279	0.4604	-0.7030	0.99998	214055.4	16.0
		(-15.2070)	(12.8477)	(6.6703)	(-2.6227)			
88 Books	273	-5.5670	0.0037	0.3644	-0.0106	0.99998	217285.9	16.0
		(-0.6477)	(0.7124)	(2.0285)	(-0.0396)			
89 Miscellaneous publishing	274	-49.7569	0.0256	0.1873	0.6316	0.99965	34714.7	16.0
		(-2.7667)	(2.6690)	(1.5276)	(1.5715)			
90 Commercial printing and business forms	275,276	-4.1738	0.0026	0.6729	-0.5572	0.99999	799924.1	16.0
		(-0.6215)	(0.6891)	(8.0406)	(-3.7202)			
91 Greeting cards	277	-30.6236	0.0178	0.0633	-0.5400	0.99994	93561.1	16.0
		(-2.9408)	(3.1146)	(0.4106)	(-3.3130)			
92 Blankbooks and bookbinding	278	-1.4268	0.0007	0.4933	0.3020	0.99995	111759.2	16.0
		(-0.2481)	(0.2163)	(4.1715)	(1.2792)			
93 Service industries for the printing trade	279	-48.0178	0.0263	0.2255	-0.4972	0.99990	52217.5	16.0
		(-1.0934)	(1.0824)	(0.6585)	(-0.8335)			
94 Industrial chemicals	281,286	9.3085	-0.0019	0.1294	-0.2087	0.99997	187305.8	16.0
		(1.6814)	(-0.6199)	(1.4249)	(-2.4444)			
95 Plastics materials and synthetics	282	27.5014	-0.0116	0.1598	-0.2199	0.99995	100174.4	16.0
		(1.6983)	(-1.1969)	(0.8343)	(-1.0555)			
96 Drugs	283	25.2127	0.0147	0.3798	-0.6456	0.99999	941649.9	16.0
		(-1.9684)	(1.9533)	(2.5772)	(-2.5687)			
97 Soap, cleaners, and toilet goods	284	-30.0678	0.0173	0.2805	-0.5344	0.99999	866323.3	16.0
		(-9.3784)	(9.0994)	(3.3798)	(-6.8709)			
98 Paints and allied products	285	18.9351	-0.0094	0.5525	-0.2788	0.99998	282747.5	16.0
		(3.1897)	(-2.7591)	(5.2935)	(-1.8411)			
99 Agricultural chemicals	287	25.1796	-0.0132	0.6750	-0.2576	0.99992	63087.3	16.0
		(1.5078)	(-1.3980)	(2.9397)	(-1.4611)			
100 Miscellaneous chemical products	289	-3.4182	0.0030	0.3315	-0.1955	0.99998	252348.6	16.0
		(-0.4924)	(0.7838)	(4.0901)	(-1.8223)			
101 Petroleum refining	291	27.1435	-0.0079	-0.4345	-0.2187	0.99995	97886.6	16.0
		(4.9010)	(-2.5453)	(-2.7855)	(-4.8990)			
102 Miscellaneous petroleum and coal products	295,299	-10.2074	0.0055	0.5154	-0.4439	0.99993	77795.6	16.0
		(-1.4582)	(1.6741)	(4.3153)	(-3.4975)			
103 Tires and inner tubes	301	9.1180	-0.0026	0.3095	-0.5767	0.99993	73831.3	16.0
		(0.6226)	(-0.3388)	(2.6267)	(-3.0476)			
104 Rubber products and plastic hose and footwear	302,305,306	12.2273	-0.0055	0.6188	-0.5753	0.99999	1025254.8	16.0
		(3.1421)	(-2.5070)	(12.6567)	(-4.4419)			
105 Miscellaneous plastics products, nec.	308	-15.3641	0.0085	0.5903	-0.4394	0.99998	256145.3	16.0
		(-0.7244)	(0.7369)	(4.7177)	(-1.5420)			
106 Footwear, except rubber and plastic	313,314	28.5624	-0.0152	0.8912	-0.3991	0.99996	318468.3	16.0
		(3.2710)	(-3.6758)	(10.1783)	(-3.3110)			
107 Luggage, handbags, and leather products, nec.	311,315-317,319	41.9206	-0.0212	0.5958	-0.0299	0.99986	38531.0	16.0
		(4.1346)	(-4.5811)	(3.7776)	(-0.1291)			
108 Railroad transportation	40	55.5564	-0.0287	0.7578	0.0436	0.99997	179510.2	16.0
		(5.7100)	(-7.2742)	(4.2058)	(0.3652)			
109 Local and interurban passenger transit	41	-21.6259	0.0078	1.1254	0.7643	0.99992	69052.6	16.0
		(-2.2067)	(1.0812)	(2.1176)	(2.8886)			
110 Trucking and warehousing	42	8.9361	-0.0027	0.4150	-0.2298	0.99998	318040.8	16.0

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Industry	SIC	Intercept	Year	ln(Output)	ln(W/P)			
		a0	a1	a2	a3	R-squared	F-value	Degrees Freedom
		(1.1491)	(-0.5294)	(2.3878)	(-0.9231)			
111 Water transportation	44	23.9355	-0.0101	0.2662	-0.2663	0.99994	88831.2	16.0
		(5.2211)	(-3.8363)	(1.5562)	(-0.8964)			
112 Air transportation	45	-98.2867	0.0524	0.3354	-0.8628	0.99985	34887.6	16.0
		(-1.7777)	(1.7107)	(0.7330)	(-2.3563)			
113 Pipelines, except natural gas	46	-3.4430	0.0029	0.2447	-0.2568	0.99987	42163.0	16.0
		(-0.7426)	(0.8850)	(0.7179)	(-3.4932)			
114 Passenger transportation arrangement	472	-40.9878	0.0201	0.6191	0.4144	0.99991	59621.1	16.0
		(-2.8718)	(2.6369)	(5.9817)	(0.7710)			
115 Miscellaneous transportation services	473,474,478	-72.0493	0.0362	0.1351	0.1662	0.99997	193931.7	16.0
		(-10.5642)	(10.6272)	(1.9522)	(0.9493)			
116 Communications	48	34.4589	-0.0174	0.7172	-0.3204	0.99999	654261.0	16.0
		(5.5193)	(-4.9812)	(7.4654)	(-1.4867)			
117 Electric utilities	491, %493	5.4576	-0.0048	1.0306	-0.3743	0.99997	177796.1	16.0
		(0.2543)	(-0.3539)	(2.2998)	(-1.6938)			
118 Gas utilities	492, %493	5.3923	0.0007	-0.0170	-0.1359	0.99999	921955.8	16.0
		(0.8688)	(0.2652)	(-0.1522)	(-2.3237)			
119 Water and sanitation	494-497, %493	-35.1787	0.0182	0.8909	-1.4254	0.99991	58594.7	16.0
		(-1.5382)	(1.4284)	(2.5437)	(-3.1946)			
120 Wholesale trade	50,51	27.9351	-0.0132	0.5725	0.0310	0.99999	618284.1	16.0
		(1.1871)	(-1.0057)	(2.7348)	(0.1435)			
121 Retail trade exc eating and drinking places	52-57,59	1.5824	0.0014	0.4127	0.0158	1.00000	1390739.5	16.0
		(0.2304)	(0.3447)	(4.0409)	(0.0859)			
122 Eating and drinking places	58	-71.6102	0.0433	-0.1193	-1.9689	1.00000	1242224.7	16.0
		(-7.9531)	(7.2994)	(-0.5938)	(-5.8578)			
123 Depository institutions	60	59.2647	-0.0305	0.9555	-0.8423	0.99997	170993.3	16.0
		(3.7387)	(-3.6279)	(5.6253)	(-3.2258)			
124 Nondepository; holding and investment offices	61,67	-63.3303	0.0331	0.4507	-0.1003	0.99997	161374.4	16.0
		(-6.0913)	(5.5198)	(2.9609)	(-1.4696)			
125 Security and commodity brokers	62	-46.8675	0.0243	0.6620	-0.5803	0.99965	35938.2	16.0
		(-1.4246)	(1.3974)	(3.2680)	(-2.5491)			
126 Insurance carriers	63	-26.6285	0.0164	0.1567	0.0127	0.99999	950616.8	16.0
		(-5.9689)	(5.4639)	(1.1841)	(0.1398)			
127 Insurance agents, brokers, and service	64	-71.7744	0.0380	0.2121	0.3193	0.99999	441389.5	16.0
		(-18.9374)	(18.5972)	(2.6737)	(2.1680)			
128 Real estate	65	57.4104	-0.0431	2.7055	0.3120	1.00000	1779842.6	16.0
		(6.2810)	(-6.9453)	(10.0448)	(1.7332)			
129 Royalties	n.a.	0.0000	0.0000	0.0000	0.0000	0.00000	0.0	0.0
		(0.0000)	(0.0000)	(0.0000)	(0.0000)			
130 Owner-occupied dwellings	n.a.	0.0000	0.0000	0.0000	0.0000	0.00000	0.0	0.0
		(0.0000)	(0.0000)	(0.0000)	(0.0000)			
131 Hotels and other lodging places	70	-61.6769	0.0320	0.4714	0.2380	0.99998	291128.6	16.0
		(-6.9088)	(7.2643)	(3.2812)	(0.8316)			
132 Laundry, cleaning, and shoe repair	721,725	-38.8627	0.0171	0.9503	0.9950	0.99999	902326.3	16.0
		(-7.0726)	(7.2072)	(10.3022)	(4.3070)			
133 Personal services, nec.	722,729	-80.5287	0.0431	0.3255	-1.3396	0.99978	23864.6	16.0
		(-4.4530)	(4.6291)	(1.7341)	(-7.4301)			
134 Beauty and barber shops	723,724	-17.1988	0.0109	0.3708	-0.8215	0.99999	472565.6	16.0
		(-7.2730)	(7.7640)	(5.0935)	(-3.2298)			
135 Funeral service and crematories	726	-19.1338	0.0119	0.2634	-0.7371	0.99999	362631.1	16.0
		(-6.5095)	(6.5759)	(3.3079)	(-24.5859)			
136 Advertising	731	-14.0280	0.0052	0.6042	0.6170	0.99995	101747.8	16.0
		(-1.0408)	(0.6726)	(3.4868)	(1.1753)			
137 Services to buildings	734	-33.1464	0.0189	0.4171	-0.8306	0.99998	302270.2	16.0
		(-3.0493)	(3.1162)	(3.7816)	(-3.3377)			
138 Miscellaneous equipment rental and leasing	735	-92.7223	0.0485	0.2803	-0.2634	0.99986	38106.6	16.0
		(-4.1221)	(4.2794)	(1.9801)	(-0.7342)			
139 Personnel supply services	736	-89.3705	0.0451	0.7580	-0.2298	0.99988	44574.2	16.0
		(-2.6790)	(2.5260)	(3.7438)	(-0.7404)			
140 Computer and data processing services	737	-157.5773	0.0828	0.5470	-2.0579	0.99993	74911.7	16.0
		(-3.1268)	(3.0850)	(3.3857)	(-3.6369)			
141 Miscellaneous business services	732,733,738	-85.9316	0.0475	0.1519	-0.9942	0.99999	469921.8	16.0
		(-20.7123)	(18.9658)	(1.2698)	(-3.7986)			
142 Automotive rentals, without drivers	751	-39.2635	0.0258	-0.1090	-1.9422	0.99989	46650.4	16.0
		(-1.6029)	(1.9875)	(-0.6365)	(-4.4893)			
143 Automobile parking, repair, and services	752-754	-37.6386	0.0204	0.5962	-1.0736	1.00000	1238412.0	16.0
		(-8.8647)	(9.4467)	(9.5933)	(-2.8558)			
144 Electrical repair shops	762	-9.8759	0.0066	-0.0508	0.9809	0.99998	214397.1	16.0
		(-2.1337)	(2.4846)	(-0.5838)	(6.7287)			
145 Watch, jewelry, & furniture repair	[illegible] 764	14.9514	-0.0058	-0.0138	0.3105	0.99991	81013.2	16.0
		(2.9814)	(-2.0710)	(-0.1309)	(0.8536)			
146 Miscellaneous repair services	769	-44.9398	0.0229	0.4489	0.3889	0.99998	312732.5	16.0
		(-10.0253)	(9.5579)	(6.4283)	(3.7384)			

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Table 1 Labor Demand Estimated Equations

Industry	SIC	Intercept	Year	ln(Output)	ln(W/P)			
		a0	a1	a2	a3	R-squared	F-value	Degrees Freedom
147 Motion pictures	781-783	-36.4131	0.0209	0.3150	-0.8449	0.99997	199243.8	16.0
		(-3.0709)	(3.1394)	(2.3666)	(-7.6981)			
148 Video tape rental	784	-65.3647	0.0353	0.2329	-0.9185	0.99984	18761.3	9.0
		(-1.8119)	(1.8993)	(4.0292)	(-2.4724)			
149 Producers, orchestras, and entertainers	792	-20.7704	0.0110	0.4251	0.0454	0.99992	87556.5	16.0
		(-1.0310)	(1.0099)	(2.3416)	(0.1686)			
150 Bowling centers	793	24.0072	-0.0103	0.1752	-0.0683	0.99999	361987.5	16.0
		(1.9229)	(-1.7061)	(1.5145)	(-0.1477)			
151 Commercial sports	794	-52.3413	0.0329	-0.7666	-0.3467	0.99990	50882.9	16.0
		(-3.7772)	(4.7234)	(-3.4659)	(-1.6521)			
152 Amusement and recreation services, nec.	791,799	-30.4977	0.0169	0.6614	-1.4399	0.99998	278799.8	16.0
		(-1.9243)	(1.8870)	(3.7359)	(-4.1350)			
153 Offices of health practitioners	801-804	-89.9287	0.0489	0.0733	-0.0299	1.00000	1830928.0	16.0
		(-10.4395)	(9.6467)	(0.5318)	(-0.3009)			
154 Nursing and personal care facilities	805	-44.8297	0.0249	0.3477	-0.3450	1.00000	2924178.4	16.0
		(-3.5623)	(3.5065)	(2.5794)	(-2.2479)			
155 Hospitals	806	-7.9278	0.0047	0.6522	-0.2529	0.99999	1042662.7	16.0
		(-0.5340)	(0.4954)	(2.2520)	(-0.7786)			
156 Health services, nec.	807-809	-153.9704	0.0826	-0.1321	-0.7661	0.99999	753813.5	16.0
		(-25.0629)	(27.4113)	(-2.2181)	(-3.7524)			
157 Legal services	81	-81.9647	0.0431	0.6189	-1.1309	0.99991	59415.3	16.0
		(-3.7296)	(3.3368)	(1.1830)	(-1.2218)			
158 Educational services	82	-0.6975	-0.0025	1.2380	-0.0804	0.99999	850703.6	16.0
		(-0.0611)	(-0.3600)	(4.3193)	(-0.6230)			
159 Individual and miscellaneous social services	832,839	-123.0100	0.0663	-0.0618	-1.1121	0.99999	896100.2	16.0
		(-6.6299)	(6.5798)	(-0.4123)	(-10.2728)			
160 Job training and related services	833	-86.7001	0.0487	-0.4999	0.1198	0.99964	15011.0	16.0
		(-4.1729)	(4.8425)	(-1.6375)	(0.7881)			
161 Child day care services	835	-92.8797	0.0514	-0.2062	-0.4805	0.99991	56146.5	16.0
		(-7.7017)	(7.6468)	(-1.2590)	(-1.4615)			
162 Residential care	836	-171.0196	0.0907	-0.1590	-0.6107	0.99996	123192.6	16.0
		(-4.0972)	(3.9906)	(-0.5008)	(-1.4616)			
163 Museums, botanical, zoological gardens	84	-71.0633	0.0373	0.1836	0.0413	0.99995	108900.2	16.0
		(-3.0291)	(2.9756)	(1.0001)	(0.2900)			
164 Membership organizations	86	-2.5140	-0.0002	1.2520	-1.3213	0.99994	85494.7	16.0
		(-0.1001)	(-0.0133)	(2.5306)	(-2.2122)			
165 Engineering and architectural services	871	-19.1421	0.0110	0.5160	-0.4073	0.99999	390649.2	16.0
		(-3.3606)	(3.2912)	(9.6198)	(-0.9365)			
166 Research and testing services	873	-76.6249	0.0424	0.1321	-0.7783	0.99998	329888.7	16.0
		(-6.4680)	(6.5231)	(1.3977)	(-3.5544)			
167 Management and public relations	874	-80.3204	0.0416	0.3329	0.2892	0.99998	289624.4	16.0
		(-4.0149)	(3.8311)	(3.9589)	(1.0690)			
168 Accounting, auditing, and other services	872,89	-64.2860	0.0349	0.2903	-0.4800	0.99990	54600.2	16.0
		(-2.0249)	(2.2045)	(1.1631)	(-0.6559)			
169 Private households	88	18.6684	-0.0069	0.3441	-0.4448	0.99993	74945.2	16.0
		(3.4338)	(-2.5126)	(1.9883)	(-1.9083)			
170 US Postal Service	431	4.6608	-0.0006	0.4111		0.99997	270074.9	17.0
		(0.3818)	(-0.1174)	(2.1926)				
171 Federal electric utilities	NA	49.9841	-0.0254	0.5374		0.99839	5267.3	17.0
		(3.1725)	(-3.4480)	(0.7808)				
172 Federal government enterprises, nec.	NA	18.0423	-0.0056	-0.1243		0.99978	38726.0	17.0
		(-0.7367)	(0.2696)	(0.4537)				
173 Federal general government	NA	1.9932	0.0016	0.2482		0.99999	1691736.5	17.0
		(1.1921)	(1.7723)	(1.8814)				
174 Local government passenger transit	NA	-80.4680	0.0297	0.8469		0.99986	59756.8	17.0
		(-10.2594)	(8.8368)	(2.7958)				
175 State and local electric utilities	NA	-41.2766	0.0246	-0.2469		0.99995	179054.8	17.0
		(-12.7149)	(12.8727)	(-2.4944)				
176 State and local government enterprises, nec.	NA	8.4345	-0.0064	1.0410		0.99998	355841.9	17.0
		(0.8983)	(-1.0048)	(3.2933)				
177 State and local government hospitals	NA	25.6619	-0.0151	1.1553		1.00000	2186988.6	17.0
		(9.4750)	(-7.4702)	(8.5057)				
178 State and local government education	NA	-9.5902	0.0032	1.0411		1.00000	8006259.5	17.0
		(-5.3236)	(1.8952)	(7.6138)				
179 State and local general government, nec.	NA	-5.2047	0.0031	0.6943		0.99999	955543.1	17.0
		(-0.8880)	(0.7554)	(3.3076)				

A Model of Detailed Personal Consumption Expenditures

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Introduction

The final product of the Office of Employment Projections is medium term (10 year) projections of over 500 occupations and 185 industries. The 6 steps involved in developing these projections are: 1) the size and demographic composition of the labor force; 2) the growth of the aggregate economy; 3) final demand or gross domestic product (GDP) subdivided by consuming sector and product; 4) inter-industry relationships (input-output); 5) industry output and employment; and 6) occupational employment.

The Personal Consumption Expenditures (PCE) Model falls under step 3. Within step 3, each component of GDP is projected—PCE, business investment, government spending and foreign trade. This paper presents a dynamic model for PCE that projects consumer spending for 80 product groups.[1] It was originally estimated by Houthakker-Taylor[2] in the mid-1960's and is based on the theory that current consumer purchases depend not only on current income and relative prices, but on a stock variable representing either the adjustment of a pre-existing inventory of the product in question to a desired or equilibrium level, or habit formation from past consumption.

The Functional Form

The standard approach to demand analysis involves estimation of the following demand equation:

$$(1)\ q_{it} = f_i(x_t, p_{it}, z_{1t}, z_{2t}, \ldots, z_{nt}, u_{it})$$

where:

q_{it}: per capita consumption of the ith commodity in year t

f_i: function whose mathematical form is specified later

x_t: per capita real disposable income

p_{it}: deflated price of the ith commodity

$z_{1t}, z_{2t}, \ldots, z_{nt}$: any other explanatory variables, such as the price of one or more substitute or complimentary goods of the ith commodity, lagged values of x_t or p_{it}, or a time trend.

U_{it}: disturbance term representing both the effect of variables that are not explicitly introduced into the equation and errors in measurement of q_{it}.

Derivation of the PCE Model

A structural equation corresponding to the above functional form is specified as:

$$(2)\ q_t = a + bs_t + cx_t + dp_t + u_t$$

where:

s: state variable

b: state coefficient

c: short-run derivative of consumption with respect to income (the marginal propensity to consume)

d: short-run derivative of consumption with respect to relative price

To define the state variable in (2), the change in either of the two types of stocks (inventory or habit formation) is assumed to be new purchases less the depreciation of existing stock, where the depreciation rate is assumed constant. This stock depreciation equation is expressed as:

$$(3)\ \dot{s}_t = q_t - es_t$$

where:

$\dot{s}$: the rate of change in the stock

and either

e= a constant rate of stock depreciation for goods

or

e=a constant rate at which habit-formation wears off

s can now be eliminated by combining (2) and (3):

$$(4)\ \dot{s}_t = q_t - (e/b) * (q_t - a - cx_t - dp_t)$$

Differentiating (2) with respect to time, substituting (4) for $\dot{s}$, and combining the different variables yields:

$$(5)\ \dot{q}_t = ae + (b-e)q_t + cex_t + dep_t + c\dot{x}_t + d\dot{p}_t$$

(5) is a first-order difference equation that deals only with the variables q, x and p, all of which are 'observed' variables.

Before estimating the model, q_t must be eliminated from the right hand side of (5). For computational reasons, it is also desirable to eliminate the current year values of x and p. Rewriting (5) to accomplish these two items yields:

$$(6)\ q_t = \frac{ae}{1-1/2(b-e)} + \frac{1+1/2(b-e)}{1-1/2(b-e)} q_{t-1} + \frac{c(1+e/2)}{1-1/2(b-e)} zx_t + \frac{ce}{1-1/2(b-e)} x_{t-1} + \frac{d(1+e/2)}{1-1/2(b-e)} zp_t + \frac{de}{1-1/2(b-e)} p_{t-1}$$

where $zx_t = x_t - x_{t-1}$ and $zp_t = p_t - p_{t-1}$

Combining the coefficients of (6) yields the:

Equation to be Estimated:

$$(7)\ q_t = A_0 + A_1 q_{t-1} + A_2 \Delta X_t + A_3 X_{t-1} + A_4 \Delta p_t + A_5 p_{t-1}$$

where:

q_t: per capita PCE of the item in question in year t (millions of chain weighted 1992 dollars)

q_{t-1}: lagged value of q

X_t: total per capita PCE in year t (millions of chain weighted 1992 dollars) (a proxy for per capita personal disposable income)

$\Delta X_t = X_t - X_{t-1}$: change in per capita PCE

X_{t-1}: lagged value of X

p_t: relative price in year t of the good in question (1992=100), calculated as the implicit deflator for that good divided by the implicit deflator for total PCE

$\Delta p_t = p_t - p_{t-1}$: change in relative price of the good in question

p_{t-1}=lagged relative price

Estimation Procedure

The PCE model was estimated using the following *Historical Data Sources*:

q_t: National Income and Product Accounts, Bureau of Economic Analysis, Commerce Department (the conversion to per capita is made using the Total Population figures from the macro econometric model—this number includes Armed Forces overseas and is in millions)

X_t: National Income and Product Accounts, Bureau of Economic Analysis, Commerce Department

p_t: National Income and Product Accounts, Bureau of Economic Analysis, Commerce Department

The regression equations for the 80 PCE product categories were estimated with ordinary least squares. Several specifications of the equation—with and without prices and with and without the income variable—were estimated for each product category to determine the best fit possible. The specification was chosen based not only on an evaluation of the regression statistics, such as the signs of the coefficients, the t-tests for the individual coefficients, the F-tests for the equation, and the R^2's, but on simulations. The simulations used the equations to estimate the historical data so that the residuals could be examined. The residuals were analyzed by looking for: positive or negative groupings of error terms; outliers; tails at the end of the historical series that would indicate problems in using the equation to project; and similar patterns among the residuals of different equations. See Table 2 for the equation coefficients and related statistics.

Given the problem of serial correlation in time series data, tests were performed to determine whether the error terms were correlated. Ordinarily, the Durbin Watson d Statistic would be used to test for positive or negative serial correlation. However, when an equation includes a lagged dependent variable as one of the independent variables, the d statistic cannot be used (it is biased toward 2, which would suggest no serial correlation). Instead, testing for serial correlation is done with a normally distributed statistic, Durbin's *h* Statistic.[3] Of the 80 PCE equations, seven (equations 33, 34, 40, 47, 56, 75 and 77) were corrected for serial correlation using an iterative procedure in which estimates for rho (p, where $u_t = pu_{t-1} + e_t$) were derived at each iteration. The rho-transformed variables were then used for the next iteration. Table 2 includes the coefficients and regression statistics for all equations, including those corrected for serial correlation. Note that the summary statistics are based on the rho-transformed variables.

Projecting with the PCE Model

Once the equation specifications were finalized based on the evaluation described in the preceding section, the projections were made using the following *Projected Data Sources for Independent Variables:*

q_{t-1}: The dependent variable generated for each year's projection is used as the lagged dependent variable in the following year.

X_t: Generated by the OEP macro econometric model

p_t: the implicit deflator for the good in question is calculated using a double exponential smoothing technique[4] and the implicit deflator for total PCE comes from OEP's macro econometric model

How the PCE Model Fits into the OEP

The results from the PCE model were then converted to projections of consumer spending by commodity through a projected bridge table. The bridge table is based on the Input-Output Tables published every 5 years by the Bureau of Economic Analysis (BEA). The commodity specific projections are converted to industry output projections using "Use" and "Make" tables, which are also based on the Input-Output Tables from BEA. The ultimate product of the OEP—industry and employment projections—are then derived from these projected outputs.

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[1] See Table 1 fore the list of the 80 product groups.

[2] H.S. Houthakker and Lester D. Taylor. *Consumer Demand in the United States, 1929-1970, Analyses and Projections*, Cambridge: Harvard University Press; 1966.

[3] $h = (1-.5DW)\sqrt{n/(1-n*s2)}$

where:

DW= Durbin Watson d Statistic

n= number of observations

s2= s squared, the estimated variance of the estimated coefficient of the lagged dependent variable

[4] The technique fits a trend model across time such that the most recent data are weighted more heavily than data in the early part of the series. The weight of an observation is given by an exponential function of the number of periods that the observation extends into the past relative to the current period.

Table 1. PCE Product Categories

1 Motor vehicles
2 Tires, tubes, and parts
3 Household furniture
4 Household appliances
5 China, glassware, and utensils
6 Video & audio products, computing equipment, & musical instruments
7 Other durable housefurnishings (floor coverings, clocks, lamps & art, textile products)
8 Jewelry and watches
9 Ophthalmic and orthopedic products
10 Books and maps
11 Wheel goods, durable toys, and sports equipment
12 Food for off-premise consumption (excluding alcohol)
13 Purchased meals and beverages
14 Food furnished to employees
15 Food produced and consumed on farms
16 Alcoholic beverages (in off-premise)
17 Shoes
18 Clothing and luggage
19 Military issue clothing
20 Gasoline and oil
21 Other fuels
22 Tobacco products
23 Toilet articles and preparations
24 Semidurable house furnishings [misc. textile products(brushes, brooms, lampshades)glass products; and plastic products]
25 Cleaning and miscellaneous household supplies & paper products
26 Stationery and writing supplies
27 Drug preparations and sundries
28 Magazines, newspapers, and sheet music
29 Nondurable toys and sporting goods
30 Flowers, seeds, and potted plants
31 Expenditures abroad by U.S. residents
32 Personal remittances to nonresidents
33 Space rent from owner-occupied nonfarm dwellings
34 Rent from tenant-occupied nonfarm dwellings
35 Rental value of farm dwellings
36 Other housing (hotels and other lodging places
37 Electricity
38 Gas
39 Telephone and telegraph
40 Water and sanitary services
41 Domestic services
42 Other household operation
43 Automobile repair
44 Bridge, tunnel, ferry and road tolls
45 Automobile insurance less claims paid
46 Intracity mass transit
47 Taxicabs
48 Railway transportation
49 Intercity bus

50	Airline transportation
51	Other intercity transportation
52	Physicians
53	Dentists
54	Other professional medical services
55	Hospitals and nursing homes
	55A Hospitals
	55B Nursing homes
56	Cleaning, storage, and repair of clothing & shoes
57	Miscellaneous personal, clothing, and jewelry services
58	Barbershops, beauty parlors, and health clubs
59	Health insurance
60	Brokerage charges and investment counseling
61	Bank service charges
62	Services furnished without payment by financial intermediaries
63	Expense of handling life insurance
64	Legal services
65	Funeral and burial expenses
66	Other personal business services
67	Radio and television repair
68	Motion picture admissions
69	Legitimate theater admissions
70	Admissions to sports events
71	Clubs and fraternal organizations
72	Commercial participant amusements
73	Pari-mutuel net receipts
74	Other recreation services
75	Higher education
76	Elementary and secondary education
77	Other private education and research
78	Religious and welfare activities
79	Foreign travel by U.S. residents
80	Expenditures in the U.S. by foreigners

Table 2. PCE Model Coefficients (with corresponding t-statistics)

Eqn		intercept	lagged dependent	change in per capita PCE	lagged per capita PCE	change in relative price	lagged relative price	R-squared	F-value
1	Motor Vehicles	-69.165068	0.665869	0.22608	0.016067	0	0		
		-3.508	9.935	12.994	4.189			0.9828	609.84
2	Tires tubes accessories	-10.1904849	0.8402261	0.01032823	0.001858	0	0		
	& other parts	-1.539	7.411	4.49	1.511			0.9936	1644.058
3	Furniture, including	-4.109523266	0.7242035	0.01877184	0.002763	0	0		
	matresses and bedsprings	-1.301	4.985	5.409	1.932			0.9822	587.63
4	Kitchen & other household	-2.433643351	0.9064753	0.0110716	0.000608	0	0		
	appliances	-1.286	9.978	5.779	1.113			0.9833	626.177
5	China, glassware,	5.35669551	0.8649853	0.00467677	0.00068	-34.5153	-5.10335		
	tableware and utensils	0.886	7.093	3.067	1.167	-2.388	-1.098	0.9869	451.087
6	Video & audio products,	114.5666581	1.2630805	0.00903983	-0.008044	-19.1449	-8.52689		
	computers & musical instruments	2.44	55.898	2.52	-2.855	-1.492	-2.39	0.9985	3945.743
7	Other durable	-10.43959892	0.9150171	0.01928001	0.001539	0	0		
	housefurnishings	-1.65	9.422	7.084	1.102			0.9942	1837.946
8	Jewelry & watches	59.67019616	0.7487659	0.01240473	0.000963	-64.4086	-44.8662		
		2.793	8.029	4.134	1.031	-3.937	-3.207	0.993	856.148
9	Opthalmic products &	-3.957224542	0.8886221	0.00580455	0.000514	0	0		
	orthopedic appliances	-1.808	10.49	3.574	1.508			0.974	398.916
10	Books & maps	3.64031853	0.7524215	0.00207436	0.000724	-63.4757	2.114598		
		0.512	6.432	0.951	0.948	-2.97	0.156	0.9453	103.763
11	Wheel goods, sports & photo equipment, boats & pleasure aircraft	-14.32139871	0.8760107	0.0190725	0.001844	0	0		
		-1.5	6.388	4.781	1.119			0.9833	628.543
12	Food purchased for off premise	195.0733028	0.8373804	0.04950332	0.001842	0	0		
	consumption	1.877	9.566	3.081	0.948			0.8998	95.81
13	Purchased meals & beverages	49.72053746	0.679777	0.05094726	0.014875	0	0		
		1.852	4.918	5.674	2.38			0.9937	1690.703
14	Food furnished to employees	7.331023391	0.8743301	-0.0021527	-0.000201	0	0		
		1.69	10.415	-1.568	-1.48			0.8768	75.884
15	Food produced and consumed	4.501447118	0.7805485	-0.0009165	-0.000242	0	0		
	on farms	2.558	13.617	-1.991	-2.364			0.9865	778.637
16	Alcohol beverages purchased for	8.432669861	0.9907576	0.00760356	-0.000469	0	0		
	off-premise consumption	1.89	18.442	1.714	-0.573			0.9839	650.865
17	Shoes	-2.030890189	0.8849396	0.01005989	0.001007	0	0		
		-0.884	11.197	5.042	1.781			0.9878	865.404

Table 2. PCE Model Coefficients (with corresponding t-statistics)

Eqn		intercept	lagged dependent	change in per capita PCE	lagged per capita PCE	change in relative price	lagged relative price	R-squared	F-value
18	Clothing & luggage	-27.56525987	0.9386914	0.04724968	0.004923	0	0		
		-2.051	14.989	5.513	1.418			0.996	2625.051
19	Military clothing	0.592165344	0.766812	-3.72E-06	-3.03E-05	0	0		
		2.052	7.229	-1.80E-02	-1.716			0.7185	27.221
20	Gasoline & oil	21.99757699	1.0105687	0.02503072	-0.001281	-48.3427	-10.9281		
		2.453	24.572	4.703	-1.605	-3.971	-2.053	0.99	592.411
21	Fuel oil & coal	44.19687801	0.7975012	0.0180928	-0.001852	-15.1241	-10.1809		
		1.795	8.164	4.134	-1.736	-1.537	-2.494	0.9862	430.323
22	Tobacco products	124.7230478	0.7151042	0.00347347	-0.001267	-183.04	-55.0203		
		1.689	4.209	0.657	-1.809	-3.497	-1.361	0.9714	203.585
23	Toilet articles &	-0.876664776	0.7359864	0.00859361	0.002586	0	0		
	preparations	-0.421	9.135	4.937	3.02			0.9951	2182.647
24	Semi-durable house	-0.429708958	0.9210679	0.00800665	0.000434	0	0		
	furnishings	-0.197	10.507	4.957	1.078			0.9789	495.244
25	Cleaning & polishing preparations,	14.76823488	0.8051723	0.00832595	0.001165	0	0		
	& misc hh supplies and paper	2.563	10.232	1.995	1.695			0.9545	223.512
26	Stationery & writing supplies	20.02803626	0.68983	0.00296569	0.000785	-38.8391	-16.6268		
		2.093	5.285	2.912	2.226	-4.225	-2.175	0.9881	497.803
27	Drug preps & sundries	-5.061206039	0.8486983	0.0020434	0.003289	0	0		
		-0.637	12.381	0.584	1.944			0.9963	2844.121
28	Magazines & newspapers & sheet	20.10697233	0.9212841	0.00643461	0.000827	-169.213	-26.8674		
	music	0.642	10.136	1.276	0.406	-4.231	-0.401	0.9012	54.758
29	Nondurable toys & sport supplies	-9.58111687	1.1140654	0.0073733	-0.000442	-28.3447	4.750178		
		-0.723	14.76	5.128	-0.456	-1.711	1.008	0.9979	2854.924
30	Flowers seeds & potted plants	-3.265688273	0.836491	0.00347996	0.000673	0	0		
		-1.58	8.543	2.934	1.731			0.9846	679.903
31	Expenditures abroad	7.728292135	0.8939302	0.00060746	-0.000396	-20.7369	-0.71437		
		0.895	9.867	0.212	-0.977	-2.842	-0.074	0.9445	102.168
32	Less: remittances in kind	-0.233272949	0.8075157	-0.0002	-3.22E-05	0	0		
		-0.604	7.707	-0.555	-1.015			0.7477	31.613
33	Owner occupied nonfarm dwellings	-18.4312	0.7342	0.0131	0.0311	0	0		
	space rent	-0.5917	7.5267	1.1884	2.6888			0.9931	1487.023
34	Tenant occupied nonfarm dwellings	51.9219	0.567	0.0156	0.0136	0	0		
	rent	0.9581	1.6799	2.7413	1.3846			0.9455	179.3034

Table 2. PCE Model Coefficients (with corresponding t-statistics)

Eqn		intercept	lagged dependent	change in per capita PCE	lagged per capita PCE	change in relative price	lagged relative price	R-squared	F-value
35	Rental value of farm housing	-3.075058442	1.0440527	0.00049198	0.00017	-10.2296	-1.59999		
		-0.468	12.491	0.751	0.534	-2.437	-1.071	0.9964	1649.732
36	Other housing	30.16236256	0.6437707	0.00779096	0.003505	-76.7756	-57.7017		
		3.164	5.373	4.99	2.805	-2.872	-2.911	0.9859	418.66
37	Electricity	4.02178004	0.918343	0.00714205	0.001453	0	0		
		0.636	11.514	1.797	0.788			0.9946	1962.522
38	Natural gas	35.17793689	0.7846202	0.00364142	-3.21E-05	1.825955	-9.50096		
		3.844	11.252	1.15	-0.096	0.155	-2.248	0.8948	51.052
39	Telephone & telegraph	-23.98676262	1.0601487	0.00448537	0.000627	-46.8722	7.490352		
		-1.236	25.88	1.797	0.503	-3.108	1.318	0.9987	4529.599
40	Water & sanitary services	1.7738	0.3899	0.0017	0.0045	0	0		
		0.3565	1.7149	1.1803	2.7912			0.9375	155.0737
41	Domestic services	50.39709854	0.7482592	0.00500697	-0.000919	-14.9465	-25.3079		
		2.822	9.118	3.296	-1.989	-1.118	-3.546	0.9941	1012.106
42	Other household operation	26.32904745	0.727681	0.0125075	0.002797	-84.477	-38.0714		
		1.617	4.264	3.129	2.206	-2.332	-1.036	0.9673	177.694
43	Auto repair, rental & other	79.4767373	0.6769278	0.0445545	0.012833	-69.6816	-171.095		
		1.633	4.668	6.797	2.356	-0.443	-1.954	0.9891	543.718
44	Bridge & road tolls	1.142103506	0.9047858	0.00058075	-3.02E-05	0	0		
		2.595	15.214	1.64	-0.92			0.9134	112.459
45	Net auto insurance premiums	4.550558132	1.0269625	0.00337303	-0.000533	0	0		
		2.3	18.566	1.924	-1.557			0.9842	665.94
46	Mass transit systems	6.904058981	0.8830308	0.0003858	-9.12E-05	-22.3492	-3.29916		
		1.478	15.232	0.592	-0.632	-6.449	-1.196	0.9923	776.911
47	Taxicab	13.7742	0.729	0.0022	-0.0003	-8.4975	-7.1903		
		0.603	2.6735	2.1305	-0.5412	-0.6712	-0.379	0.6724	11.9043
48	Intercity railways	1.307523547	0.7925395	3.9156E-05	-0.000149	-6.2654	1.736944		
		1.23	9.954	0.11	-1.682	-1.97	1.645	0.9732	217.823
49	Intercity buses	1.086383969	1.0209821	0	0	-15.3683	-1.70175		
		0.594	12.382			-2.674	-1.23	0.9493	199.769
50	Airline	19.16364036	1.0443154	0.00900127	-0.00076	-36.9361	-11.1673		
		2.187	12.467	4.337	-0.919	-4.453	-2.2	0.9928	825.399
51	Other transportation services	-0.506542312	0.848938	0.00123325	0.000333	-9.0193	-3.22966		
		-0.566	7.713	3.632	1.956	-3.527	-2.401	0.9896	573.399

Table 2. PCE Model Coefficients (with corresponding t-statistics)

Eqn		intercept	lagged dependent	change in per capita PCE	lagged per capita PCE	change in relative price	lagged relative price	R-squared	F-value
52	Physicians	-14.03442139	0.791911	0.00967307	0.008981	0	0		
		-1.157	8.954	1.028	2.39			0.9913	1211.272
53	Dentists	12.56296075	0.7799664	0.00784128	0.00301	-141.009	-27.3329		
		1.233	5.719	2.879	1.38	-2.433	-1.005	0.9884	512.969
54	Other professional medical	65.3093726	0.9988075	0.01860577	0.010421	-240.088	-222.532		
		2.089	25.127	2.925	2.384	-2.462	-2.337	0.9948	1141.314
55	Hospitals & Nursing homes	20.78759	0.937729	0.011082	0.018024	-266.813	-223.72		
		0.738	21.962	1.029	2.594	-0.935	-2.699	0.9986	175.2681
56	Cleaning, storage, & repair of clothing & shoes	1.8264	0.9424	0.0065	-0.0001	0	0		
		0.1204	9.3531	4.3173	-0.1621			0.9515	202.5202
57	Misc personal, clothing & jewelry services	-9.101208133	0.672162	0.00748425	0.001535	0	0		
		-2.352	4.766	4.102	2.273			0.9758	430.094
58	Barbershops, beauty, & health	40.52502961	0.8093954	0.00933814	0.000537	-71.7242	-35.4994		
		2.527	10.785	3.657	1.204	-1.932	-2.065	0.8987	53.226
59	Health insurance	5.891828625	0.7769452	0.00558431	0.002815	-27.5207	-15.2093		
		2.41	8.908	2.457	2.603	-4.606	-2.883	0.9926	805.386
60	Brokerage charges &	3.837342246	0.8265951	0.00788671	0.002869	-14.0227	-23.9712		
	investment counseling	0.328	6.62	1.187	2.334	-0.937	-1.728	0.9608	147.132
61	Bank service charges	15.85973924	1.0996065	0.00082411	-0.00069	-19.1032	-14.937		
		1.923	10.975	0.335	-0.752	-0.775	-2.654	0.9908	647.796
62	Services furnished without payment	20.46466813	1.0182991	0.02146155	-0.00202	0	0		
	by financial intermediaries	1.338	11.76	1.875	-0.528			0.9882	889.929
63	Expense of handling life insurance	-0.997416788	0.7535678	-0.0092282	0.00419	0	0		
		-0.121	7.363	-1.228	2.29			0.9682	324.399
64	Legal services	23.61133701	0.6251781	0.0059356	0.002434	-92.4282	3.309106		
		2.818	4.615	1.518	1.464	-1.807	0.172	0.9621	152.413
65	Funeral & burial expenses	19.77258229	0.6902426	0.00265773	-0.00024	-59.9285	-3.44018		
		2.39	6.258	3.362	-2.554	-4.623	-0.883	0.9691	187.926
66	Other personal business	21.45633174	0.8883785	0.00467213	0.001124	-65.1701	-33.0244		
		3.075	13.368	6.052	2.22	-3.138	-2.878	0.9945	1075.511
67	Repair of audio & video eqpt	-1.143635698	0.9228922	0.00141543	0.000102	-11.0975	0.477366		
		-0.225	9.649	2.29	0.707	-2.072	0.29	0.9509	116.172

Table 2. PCE Model Coefficients (with corresponding t-statistics)

Eqn		intercept	lagged dependent	change in per capita PCE	lagged per capita PCE	change in relative price	lagged relative price	R-squared	F-value
68	Motion picture admissions	14.99069691	0.6289972	-0.0014543	-0.000455	0	0		
		3.076	6.384	-1.283	-2.438			0.9299	141.442
69	Live entertainment excl. sports	0.183892514	0.9616302	0.00154097	0.000286	-18.8872	-3.13738		
		0.123	13.38	2.035	1.468	-2.333	-1.294	0.9856	410.635
70	Spectator sports	5.944692177	0.8583291	0.00042772	-2.64E-05	-3.29878	-3.13147		
		1.741	9.973	0.545	-0.26	-0.312	-1.112	0.9458	104.611
71	Clubs & fraternal organizations	15.42291685	0.8992262	-6.47E-07	0.000315	-42.9759	-15.0852		
		1.641	11.159	-1.00E-03	1.931	-3.314	-1.75	0.9894	559.889
72	Commercial participant amusements	5.361446897	1.0147802	0.00264823	0.000272	-2.44101	-7.39964		
		0.237	13.3	1.316	0.355	-0.038	-0.313	0.9939	970.405
73	Pari-mutuel net receipts	2.428194668	0.9235094	0.00057839	-0.000184	-12.5072	1.118777		
		1.406	24.486	1.375	-5.218	-3.954	0.667	0.9721	209.286
74	Other recreation	33.16959623	0.9502094	0.01271414	0.001205	-88.6246	-33.3085		
		2.208	21.527	4.503	1.001	-1.898	-3.009	0.9987	4663.279
75	Higher education	21.5723	0.7922	0.0024	0.0023	114.6761	-19.3651		
		1.1651	2.5916	1.2555	0.8837	2.1638	-0.7786	0.9508	111.9822
76	Private lower education	12.04526626	0.9041854	0.00171505	0.000143	-41.5907	-7.49022		
		3.265	12.284	1.349	0.495	-2.583	-1.471	0.9606	146.26
77	Other education & research	-0.1457	0.7466	0.0069	0.0021	-18.7034	-12.9302		
		-0.008	2.3246	3.753	0.8555	-0.5707	-0.5145	0.972	201.4424
78	Religious & welfare	-13.07434988	0.977623	0.02280565	0.001827	0	0		
		-1.257	18.309	4.02	0.968			0.9956	2434.807
79	Foreign travel by U.S. residents	86.07765334	0.3663459	0.01365169	0.007324	-105.422	-98.2379		
		3.385	2.229	2.383	3.655	-3.814	-3.857	0.9828	342.098
80	Less: expenditures in U.S. by	308.5286131	0.5986434	0.00493658	-0.003654	-196.72	-355.309		
	foreigners	2.499	4.292	0.65	-2.44	-0.899	-2.272	0.9883	505.219

A COMMODITY-SPECIFIC MODEL FOR PROJECTING IMPORT DEMAND

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Introduction

The purpose of developing an import model is to refine the Bureau of Labor Statistics (BLS) projections method in the area of imports. In previous projections, imports had been treated in a manner analogous to exports.[1] The drawback with this, however, is that the commodity distribution of imports is not directly influenced by the sectoral composition of demand. To remedy this, we have developed a set of commodity-specific import functions. This import model is being used for the first time in the Bureau's projections system.[2]

The study described here is a model which estimates import flows for 107 commodities.[3] This model operates as one of several sub-models within the BLS employment projections model system. The most important element of this model is its commodity detail. As will be apparent, import demands vary considerably by commodity.

A Commodity-Specific Import Model

Import demand basically depends on the consumer's income, the price of imports, and the price of the other goods; in this case, the price of domestic goods, because individuals allocate their income among consumable commodities in an effort to achieve maximum satisfaction. This suggests that for an economy we may write import demand as:

$$M = f(Y, P_m, P_y)$$

where

M : Import demand
Y : Domestic income
P_m: Price levels of imports
P_y: Price levels of domestic goods

In addition to **income and price**, the two key variables, the Leamer and Stern model suggested that other possible explanatory variables should also be considered. A complex demand phenomenon requires more variables than the usual two. Five other variables are described in the Leamer and Stern model:[4]

1. Lagged variable: It is particularly important in measuring the influence of past changes in the independent variables on the current behavior of imports.

2. The capacity-utilization variable: An increase in domestic demand may not be met immediately by price increases. Rather, domestic producers may ration the available supply by delaying deliveries. The consumer may look to foreign sources of supply to avoid the delay in delivery and pay two prices for the goods he desires during the waiting period. Capacity utilization is a proxy to reflect the length of queues at home and abroad.

3. The dollar's exchange rate: It significantly affect the prices of foreign goods transacted from other currencies to the U.S. dollars.

4. Dummy variables for unusual periods: It allows for the effects on imports of unusual occurrences such as a strike, war, or natural disaster. Such variables would assume a value of one for the duration of the unusual period and zero otherwise.

5. Credit variable: It indicates the availability and terms at which credit is provided for the financing of imports. Such a variable is important in linking the current and capital accounts of balance of payments.

The variables discussed above are in general the most important ones, especially for the manufacturing industries, although the list is by no means all-inclusive. Many other explanatory variables will suggest themselves in particular situations.

For empirical, data availability, and accommodating reason, a commodity-specific import model is formed using a log-linear least squares regression:

$$(1)\ \log M_{it} = a_0 + a_1 \log Y_{it} + a_2 \log M_{it-1} + a_3 \log R_t + a_4 \log P_{it} + D$$

where

M: The volume (value) of imports for that commodity, 1992 dollars

Y: Total supply (domestic output plus imports) of that commodity, 1992 dollars.
R: Trade-weighted U.S. dollar's exchange rate, 1990=100.
P: Relative price imports, 1992=100, defined as the ratio of import price deflator for that commodity to comparable domestic producer price deflator for that commodity.
D: Dummy variable for the effects upon imports of unusual occurrences such as a strike, war, natural disaster, or oil price shock. One for the duration of the unusual period and zero otherwise.

and

t: time period
i: ith commodity

It is important to note that in this model, total supply, defined as domestic output plus imports, is chosen as a proxy to reflect the economy-wide demand as well as to test the sensitivity of import demand.

Estimation Procedure, Data Sources, and Regression Results

The import model estimates the import trend by commodity. The data used to implement this import model are primarily developed by BLS, Office of Employment Projections (OEP) commodity time-series data base. The import and domestic output data are estimated by OEP at 3-digit SIC level. The trade-weighted U.S. dollar's exchange rates are obtained from the OEP's macro econometric model data base. The domestic producer price index and import price index are also developed from OEP's data base and BLS estimates.

The regression equation is estimated with ordinary least squares. Several specifications of equation (1) are estimated for each commodity. This is necessary to ensure the estimation technique yields a reasonable coefficient in terms of the sign and statistical significance. The expected sign for the coefficient of total supply (a_1) and the coefficient of lagged dependent variable (a_2) should be positive, and the coefficient of exchange rate (a_3) should also hold a positive sign. On the other hand, the price coefficient (a_4) should have a negative sign. If the variable coefficients show a wrong sign, the variable are dropped from the estimated equation. For this reason, eight specifications of equation (1) are used as:

$$(1.1)\ \log M_{it} = a_0 + a_1 \log Y_{it} + a_2 \log M_{it-1} + a_3 \log R_t + a_4 \log P_{it} + D$$

$$(1.2)\ \log M_{it} = a_1 \log Y_{it} + a_2 \log M_{it-1} + a_3 \log R_t + a_4 \log P_{it} + D$$

$$(1.3)\ \log M_{it} = a_0 + a_1 \log Y_{it} + a_2 \log M_{it-1} + a_3 \log R_t + D$$

$$(1.4)\ \log M_{it} = a_1 \log Y_{it} + a_2 \log M_{it-1} + a_3 \log R_t + D$$

$$(1.5)\ \log M_{it} = a_0 + a_1 \log Y_{it} + a_2 \log M_{it-1} + a_4 \log P_{it} + D$$

$$(1.6)\ \log M_{it} = a_1 \log Y_{it} + a_2 \log M_{it-1} + a_4 \log P_{it} + D$$

$$(1.7)\ \log M_{it} = a_0 + a_1 \log Y_{it} + a_2 \log M_{it-1} + D$$

$$(1.8)\ \log M_{it} = a_1 \log Y_{it} + a_2 \log M_{it-1} + D$$

To choose among the 8 equations for each commodity, the equations are estimated over the 1977-93 period. Of the 107 commodities, 2 commodities--wood containers and miscellaneous wood products (Commodity 14) and office and miscellaneous furniture and fixtures (Commodity 17)--have data available only in the period of 1978-1993 and 1983-1993 respectively; 4 commodities--oil and gas field services (Commodity 7), construction (Commodity 9), partitions and fixtures (Commodity 16), and metal coating, engraving, and allied services (Commodity 34)--show no import values in the input-output accounts.

Table 1 shows the results that the explanatory variable coefficients have the "correct" sign. Historical simulation is also tested to examine how closely each simulated variable tracks its corresponding data series. Other statistics such as R-squared, F-values, and t-statistics are also shown in table 1.

The Projections of Commodity Trends and Aggregate Trends

To solve the projections, the variables of exchange rate can be produced by the OEP's macro econometric model, but the outputs and prices by commodity must be extrapolated from the estimated historical series. For this set of projections, due to time constraints, the projected total supply for the import model is not iteratively derived. Instead, the historical total supply series is extrapolated and used as a proxy.

As mentioned earlier, this model deals with 107 goods. However, the OEP projections system contains 185 commodities or industries. These include 107 goods, 72 services, and 6 special industries. Outside of agriculture, mining, and manufacturing, import entries only exist in 21 services and 2 special industries. (See Appendix.) Among the 21 services, almost all of their time-series data on imports are available only from 1986 to 1993. In order to project services of imports, an alternative estimating method is used.

Import demand is initially projected by the macro econometric model, which generates values for 8 major end-use categories of imports--7 for goods and 1 for services. The single column of services control is allocated among commodities based on the estimates for a most recent historical year distribution. Two special industries--noncomparable imports[5] and scrap, used and secondhand goods, are treated as dummy commodities, and are projected based on their historical trends of the commodity as a share of total imports.

To make sure the goods estimates from the model are consistent with the macro controls, the 107 estimates plus the 2 special ones are then disaggregated into 7 columns based on the bridge table developed by OEP. Obviously, summation differences are expected from these two estimates. The differences are then carefully examined and, generally, scaling adjustments are introduced in order to reproduce the macro model control values. The macro model controls may themselves be modified in response to the more finely developed detail at the commodity level of the projection.

Conclusion

Since the import model is being developed and used for the first time in the projection system, extensive work is needed to improve the model. This includes in particular the generation of proxy variables. For example, to avoid the technical simulation problem, should the lagged total supply, rather than the current value, be used as an explanatory variable in the model? To operate this import model, the price equation is essential, and a price model is also needed as a vehicle to fit the import model. It is hoped that further work with the model will truly improve the projections in the area of imports.

Footnotes

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[1] For exports, the projection process involves allocating the projected category control totals generated from the macro econometric model to commodities based on patterns estimated for a recent historical year bridge table.

[2] This system was developed by the Office of Employment Projections, Bureau of Labor Statistics. These projections cover the future size and composition of the labor force, aggregate economic growth, detailed estimates of industrial production, and industrial and occupational employment.

[3] See Table 1 for the list of 107 commodities.

[4] Leamer, Edward E. and Stern, Robert M. Quantitative International Economics (Boston, MA: Allyn and Bacon, Inc. 1970).

[5] An import is noncomparable, if (1) there is no significant domestic production, e.g., coffee beans and bananas; or (2) the item is purchased and used outside the U.S., such as consular fees and communication costs; or (3) the item is unique, such as antiques and art works.

Appendix: A List of Import-Related Services and Special Industries

1 Railroad transportation
2 Water transportation
3 Air transportation
4 Electric utilities
5 Gas utilities
6 Wholesale trade
7 Depository institutions
8 Insurance carriers
9 Advertising
10 Personnel supply services
11 Computer and data processing services
12 Miscellaneous business services
13 Miscellaneous repair services
14 Motion pictures
15 Producers, orchestras, and entertainers
16 Legal services
17 Educational services
18 Engineering and architectural services
19 Research and testing services
20 Management and public relations
21 Accounting, auditing, and other services
22 Noncomparable imports
23 Scrap, used and secondhand goods

Table 1 Import Estimating Equations

Model $\log M_{it} = a_0 + a_1 \log Y_{it} + a_2 \log M_{it-1} + a_3 \log R_t + a_4 \log P_{it}$

Commodity	Intercept	Total Supply t	Imports t-1	Exchange Rate t	Relative Price t	R-squared	F-value
	a0	a1	a2	a3	a4		
1 Agricultural production	-9.0528	0.7296	0.9391	0.1612		0.948	72.675
	(-1.1572)	(1.0691)	(9.3318)	(0.6992)			
2 Agricultural services	-5.6967	1.2825	0.1813		-1.1784	0.527	4.459
	(-0.5895)	(2.2181)	(0.6312)		(-0.7009)		
3 Forestry, fishing, hunting, and trapping	-6.2719	0.9521	0.4489	0.3720		0.926	49.713
	(-2.3581)	(2.6033)	(2.3792)	(2.0725)			
4 Metal mining		0.6211	0.3604	0.3010	-0.5157	0.542	3.548
		(2.2713)	(1.7374)	(1.3159)	(-1.3948)		
5 Coal mining	-0.3411	0.0066	1.0862			0.811	27.869
	(-0.0572)	(0.0102)	(5.4114)				
6 Crude petroleum, natural gas, and gas liquids	-3.4050	0.5782	0.6834			0.726	17.252
	(-0.3320)	(0.5294)	(2.4926)				
7 Oil and gas field services*	-	-	-	-	-	-	-
8 Nonmetallic minerals, except fuels		0.6242	0.1398			0.007	0.048
		(3.6852)	(0.5992)				
9 Construction*	-	-	-	-	-	-	-
10 Logging	-3.3471	0.3076	0.5981	0.4266		0.495	3.919
	(-0.3365)	(0.3151)	(2.5888)	(0.5848)			
11 Sawmills and planing mills		0.4063	0.3252	0.3212		0.657	8.285
		(2.0656)	(1.3331)	(2.1079)			
12 Millwork, plywood, and structural members	2.3693	0.6628	0.1343	0.0613	-0.6799	0.708	6.676
	(0.4613)	(2.7133)	(0.6267)	(0.2077)	(-1.2782)		
13 Wood containers and misc. wood products		1.1650	0.5370	0.5640	-2.2485	0.965	83.698
		(2.5649)	(2.9657)	(3.0612)	(-2.8753)		
14 Wood buildings and mobile homes		2.6119	0.6846	0.2855	-5.1375	0.609	4.289
		(2.0702)	(4.0242)	(0.3607)	(-2.0353)		
15 Household furniture	-3.8482	1.1567	0.7504	0.1349	-1.3834	0.991	312.830
	(-0.5482)	(2.5740)	(5.4403)	(0.2316)	(-1.4400)		
16 Partitions and fixtures*	-	-	-	-	-	-	-
17 Office and misc. furniture and fixtures	-9.6217	1.5587	0.0876	0.3462		0.973	146.717
	(-4.3477)	(4.6627)	(0.5104)	(2.1157)			
18 Glass and glass products	-13.3584	1.1195	0.8768	0.7029		0.974	151.656
	(-2.5849)	(2.3493)	(12.8754)	(3.3986)			
19 Hydraulic cement		1.0689	0.7570	0.3280	-2.0098	0.727	7.992
		(2.0383)	(4.3747)	(0.5816)	(-2.1509)		
20 Stone, clay, and misc. mineral products	-6.8696	0.6789	0.8485	0.2990		0.820	18.232
	(-1.2759)	(1.5338)	(6.3858)	(0.9741)			
21 Concrete, gypsum, and plaster products		0.2065	0.6662	0.0654	-0.1696	0.605	4.604
		(0.3726)	(3.3930)	(0.0980)	(-0.2738)		
22 Blast furnaces and basic steel products		0.3392	0.2319	0.7245		0.294	1.807
		(3.5518)	(1.3684)	(2.9408)			
23 Iron and steel foundries		0.1403	0.7534			0.127	1.017

Table 1 Import Estimating Equations-Continued

Model $\log M_{it} = a_0 + a_1 \log Y_{it} + a_2 \log M_{it-1} + a_3 \log R_t + a_4 \log P_{it}$

Commodity	Intercept	Total Supply t	Imports t-1	Exchange Rate t	Relative Price t	R-squared	F-value
	a0	a1	a2	a3	a4		
		(1.1847)	(3.6956)				
24 Primary nonferrous smelting and refining	2.2853	0.4646	0.1862			0.281	2.542
	(0.8086)	(1.8874)	(0.8308)				
25 All other primary metals		0.1187	0.7863			0.560	8.912
		(1.2640)	(4.9509)				
26 Nonferrous rolling and drawing	14.5343	0.8943	0.3083	0.2134	-4.1948	0.921	31.883
	(1.0266)	(1.3661)	(1.1983)	(0.5678)	(-2.3309)		
27 Nonferrous foundries		0.6249	0.6697		-0.8910	0.903	24.873
		(0.9625)	(4.3500)		(-0.7827)		
28 Metal cans and shipping containers		0.1399	0.7378			0.521	7.623
		(1.5176)	(4.1139)				
29 Cutlery, hand tools, and hardware		0.5157	0.9555	0.3989	-1.4183	0.950	57.512
		(1.4958)	(12.5068)	(1.9461)	(-1.7350)		
30 Plumbing and nonelectric heating equipment	-7.7613	1.1452	0.4377	0.2465		0.317	1.857
	(-0.6403)	(0.8289)	(1.8300)	(0.3598)			
31 Fabricated structural metal products		0.0728	0.6433	0.3158		0.437	3.362
		(0.3014)	(3.3491)	(0.6994)			
32 Screw machine products, bolts, rivets, etc.	-3.9256	1.1088	0.6117	0.0561	-0.8132	0.907	26.978
	(-0.7919)	(2.5354)	(3.0441)	(0.1435)	(-1.1857)		
33 Metal forgings and stampings	-0.9746	0.0441	0.9375	0.2136		0.893	33.478
	(-0.1894)	(0.0970)	(9.2229)	(0.6700)			
34 Metal coating, engraving, and allied services*	-	-	-	-	-	-	-
35 Ordnance and ammunition	-4.6761	0.5197	0.8484	0.2181		0.969	125.491
	(-2.6601)	(2.1725)	(7.7856)	(0.7673)			
36 Miscellaneous fabricated metal products	-15.0183	1.6480	0.5576	0.3195		0.830	19.559
	(-2.2485)	(2.7798)	(5.5819)	(1.5828)			
37 Engines and turbines	-11.9449	0.9500	1.0052	0.5255		0.858	24.163
	(-1.7248)	(2.1167)	(6.7601)	(1.1870)			
38 Farm and garden machinery and equipment	7.5676	0.0408	0.4387		-0.7514	0.595	5.877
	(1.5010)	(0.1729)	(1.8162)		(-1.5101)		
39 Construction and related machinery		0.0527	0.9082	0.3393	-0.2953	0.784	10.867
		(0.1404)	(4.1227)	(0.6815)	(-0.3678)		
40 Metalworking machinery and equipment	-6.8838	0.6218	0.7389	0.5672		0.851	22.888
	(-1.7729)	(2.2121)	(8.2347)	(2.3654)			
41 Special industry machinery	-9.5336	1.0477	0.4772	0.7386		0.901	36.565
	(-3.4320)	(4.0387)	(4.5002)	(4.3969)			
42 General industrial machinery and equipment	-5.7185	0.8954	0.7436	0.0998	-0.4108	0.945	47.007
	(-0.4564)	(1.5444)	(9.3778)	(0.0850)	(-0.3174)		
43 Computer and office equipment	-6.8881	1.3111	0.2165	0.0396		0.998	1651.783
	(-4.7845)	(4.6571)	(1.3141)	(0.1817)			
44 Refrigeration and service industry machinery	-27.4561	2.5939	0.5553	0.9291		0.958	91.044
	(-4.8575)	(4.6833)	(5.5309)	(2.7869)			
45 Industrial machinery, nec	-27.8624	3.2080	0.4470		-0.1352	0.933	55.680
	(-3.0330)	(3.6866)	(3.4299)		(-0.2967)		

Table 1 Import Estimating Equations-Continued

Model $\log M_{it} = a_0 + a_1 \log Y_{it} + a_2 \log M_{it-1} + a_3 \log R_t + a_4 \log P_{it}$

Commodity	Intercept	Total Supply t	Imports t-1	Exchange Rate t	Relative Price t	R-squared	F-value
	a0	a1	a2	a3	a4		
46 Electric distribution equipment		0.1463	0.7970	0.0176		0.555	5.405
		(0.3174)	(3.5975)	(0.0247)			
47 Electrical industrial apparatus		0.1909	0.8991	0.0208	-0.2555	0.860	18.387
		(0.5070)	(4.2866)	(0.0596)	(-0.3150)		
48 Household appliances	-10.8493	1.0676	0.7264	0.5338		0.928	51.944
	(-2.0432)	(1.6803)	(3.9996)	(2.3079)			
49 Electric lighting and wiring equipment	-12.9278	1.8406	0.4847	0.1116	-0.3905	0.967	81.476
	(-1.4091)	(3.2718)	(3.4233)	(0.0915)	(-0.3796)		
50 Household audio and video equipment	-4.5989	1.0164	0.3150	0.1983		0.986	272.003
	(-5.0848)	(5.0819)	(2.1930)	(1.1948)			
51 Communications equipment	-8.9115	1.3557	0.3061	0.1358		0.967	118.996
	(-2.6053)	(3.3605)	(1.6960)	(0.4859)			
52 Electronic components and accessories		0.8949	0.3222	0.0388	-0.7747	0.994	487.934
		(5.7875)	(2.9511)	(0.4589)	(-4.6320)		
53 Miscellaneous electrical equipment	-5.0043	0.5630	0.6524	0.4934		0.977	168.485
	(-1.9908)	(1.7244)	(4.3410)	(2.6634)			
54 Motor vehicles and equipment		0.3419	0.9276	0.0708	-0.8376	0.954	61.758
		(2.4934)	(7.6726)	(0.5783)	(-2.1803)		
55 Aerospace	-15.3566	1.6244	0.4453	0.3172		0.972	141.202
	(-3.8324)	(4.7193)	(4.7387)	(1.2013)			
56 Ship and boat building and repairing		0.1465	0.7795			0.402	4.699
		(1.0299)	(3.4388)				
57 Railroad equipment		0.2573	0.5535	0.1223		0.371	2.560
		(1.3501)	(3.2887)	(0.3516)			
58 Miscellaneous transportation equipment	1.3331	0.2160	0.6764	0.0912	-0.2987	0.562	3.536
	(0.2948)	(0.4917)	(2.7254)	(0.2536)	(-0.7855)		
59 Search and navigation equipment	-6.9627	1.3773	0.4415		-0.8263	0.864	25.414
	(-1.5993)	(1.8871)	(1.6097)		(-1.0881)		
60 Measuring and controlling devices	-11.4412	1.4547	0.4011	0.3019	-0.0237	0.991	287.608
	(-1.8801)	(4.3689)	(3.6610)	(0.6940)	(-00529)		
61 Medical equipment, instruments, and supplies	23.8178	0.5699	0.7371	0.1508	-6.1423	0.995	508.218
	(1.9989)	(2.1495)	(4.9998)	(0.9824)	(-2.2683)		
62 Ophthalmic goods		0.7246	0.5776	0.2694	-0.8982	0.980	150.288
		(3.9766)	(5.6330)	(3.4961)	(-4.8591)		
63 Photographic equipment and supplies	-17.0319	1.9596	0.4153	0.4859		0.964	108.667
	(-3.0686)	(3.1522)	(2.4916)	(2.3885)			
64 Watches, clocks, and parts	-6.9177	0.6490	0.9509	0.4353		0.918	45.027
	(-1.9585)	(2.4099)	(10.3815)	(1.5954)			
65 Jewelry, silverware, and plated ware		0.5229	0.5395	0.0082	-0.2196	0.759	9.453
		(1.1977)	(2.0955)	(0.0244)	(-0.4783)		
66 Toys and sporting goods	-3.5574	1.2691	0.4486	0.1925	-1.0711	0.994	452.086
	(-1.1998)	(6.1905)	(5.2754)	(0.8208)	(-2.3463)		
67 Manufactured products, nec		0.3066	1.0124	0.1462	-0.8380	0.962	75.385
		(0.5364)	(10.5947)	(0.7091)	(-0.8498)		
68 Meat products		0.1238	0.7905	0.2087	-0.1471	0.850	17.049

Table 1 Import Estimating Equations-Continued

Model $\log M_{it} = a_0 + a_1 \log Y_{it} + a_2 \log M_{it-1} + a_3 \log R_t + a_4 \log P_{it}$

Commodity	Intercept	Total Supply t	Imports t-1	Exchange Rate t	Relative Price t	R-squared	F-value
	a0	a1	a2	a3	a4		
		(0.6194)	(4.1350)	(1.9326)	(-0.8492)		
69 Dairy products	-4.5460	0.7963	0.3655	0.3813	-0.3745	0.782	9.863
	(-0.5574)	(0.9043)	(1.2110)	(0.9228)	(-0.9406)		
70 Preserved fruits and vegetables	-9.1740	1.2665	0.3476	0.8459	-0.6821	0.962	70.000
	(-1.4554)	(2.7194)	(2.6246)	(3.6597)	(-1.6346)		
71 Grain mill products and fats and oils		0.0219	0.9534	0.0269		0.859	26.307
		(0.0918)	(4.5897)	(0.0904)			
72 Bakery products	-11.6847	1.1452	0.9520	0.0419		0.901	36.365
	(-0.4166)	(0.4064)	(7.3062)	(0.0685)			
73 Sugar and confectionery products	-11.5713	1.6290	0.0090	0.6001		0.424	2.942
	(-1.6349)	(2.4151)	(0.0335)	(1.9813)			
74 Beverages		0.3792	0.2151	0.5859		0.651	8.069
		(3.3738)	(1.1990)	(3.6716)			
75 Miscellaneous food and kindred products	-1.9838	0.3115	0.7397	0.1885		0.940	62.198
	(-0.8974)	(1.1563)	(5.6705)	(1.8660)			
76 Tobacco products	1.2300	0.2087	0.6575		-0.1971	0.355	2.202
	(0.2189)	(0.3754)	(2.0947)		(-0.4626)		
77 Weaving, finishing, yarn, and thread mills	-19.1748	1.9686	0.7260	0.4285	-0.3081	0.919	31.164
	(-1.6621)	(2.7358)	(5.9931)	(0.6667)	(-0.2383)		
78 Knitting mills	-2.6714	0.7553	0.9607	0.1955	-1.0833	0.962	70.319
	(-0.2191)	(1.0650)	(8.5759)	(0.2154)	(-0.5614)		
79 Carpets and rugs	-4.5472	0.6591	0.6739	0.1035		0.940	62.959
	(-1.3948)	(1.9822)	(6.9830)	(0.3968)			
80 Miscellaneous textile goods		0.5539	0.4770	0.0475	-0.3992	0.644	5.419
		(2.3052)	(2.0938)	(0.2770)	(-1.3231)		
81 Apparel	-16.6047	1.6921	0.5980	0.3230		0.992	476.580
	(-5.5881)	(5.3871)	(7.8705)	(3.1624)			
82 Miscellaneous fabricated textile products	61.9525	0.5570	0.8727	0.6768	-15.1106	0.994	427.575
	(0.8302)	(1.5393)	(7.7536)	(4.2712)	(-0.9383)		
83 Pulp, paper, and paperboard mills		0.6955	0.4751	0.1501	-0.7702	0.937	44.539
		(2.9328)	(2.6844)	(1.2311)	(-2.3692)		
84 Paperboard containers and boxes	9.1072	0.8868	0.6521	0.2580	-3.7912	0.902	25.442
	(0.2648)	(0.4171)	(3.1772)	(0.2965)	(-1.1155)		
85 Converted paper products except containers		0.1874	0.8814	0.2095	-0.4369	0.970	96.628
		(0.6560)	(9.2582)	(1.0342)	(-0.7882)		
86 Newspapers	-39.8313	4.7893	0.2397	0.8413	-0.8787	0.867	17.851
	(-3.2656)	(2.6207)	(1.0752)	(1.1263)	(-1.0345)		
87 Periodicals	-1.4988	0.9598	0.2698		-0.8114	0.604	6.096
	(-0.2866)	(1.3880)	(0.9608)		(-1.7091)		
88 Books		0.2615	0.7326	0.2783	-0.4336	0.937	44.883
		(1.3370)	(5.6987)	(1.6018)	(-1.7587)		
89 Miscellaneous publishing	0.1285		0.9470			0.717	35.446
	(0.2675)		(5.9536)				
90 Commercial printing and business forms	-10.4999	1.4904	0.3498		-0.2784	0.962	102.577
	(-2.9846)	(3.0460)	(1.6887)		(-0.9845)		

Table 1 Import Estimating Equations-Continued

Model $\log M_{it} = a_0 + a_1 \log Y_{it} + a_2 \log M_{it-1} + a_3 \log R_t + a_4 \log P_{it}$

Commodity	Intercept	Total Supply t	Imports t-1	Exchange Rate t	Relative Price t	R-squared	F-value
	a0	a1	a2	a3	a4		
91 Greeting cards	-5.9901	1.2408	0.4886		-0.4455	0.973	142.406
	(-2.4183)	(2.7664)	(2.5708)		(-1.4010)		
92 Blankbooks and bookbinding	-5.3930	0.8713	0.7263	0.6049	-0.7143	0.901	25.045
	(-0.8834)	(1.3436)	(4.1561)	(2.0682)	(-1.1145)		
93 Service industries for the printing trade	-21.6951	2.6650	0.3303	0.1663		0.871	26.956
	(-4.3087)	(5.4191)	(2.2517)	(0.3144)			
94 Industrial chemicals	-5.0303	0.4952	0.8357	0.1869		0.924	48.583
	(-1.6473)	(2.2076)	(10.4551)	(1.0002)			
95 Plastics materials and synthetics		0.6468	0.9764	0.6278	-2.1135	0.952	59.378
		(1.0296)	(7.9186)	(1.8224)	(-1.3952)		
96 Drugs	-4.3556	1.1219	0.1345	0.0084		0.981	205.662
	(-2.6452)	(3.8078)	(0.6278)	(0.0825)			
97 Soap, cleaners, and toilet goods	-5.4589	1.0324	0.4847	0.2799	-0.6399	0.973	100.186
	(-0.6103)	(1.5036)	(2.7271)	(0.8610)	(-1.7682)		
98 Paints and allied products		0.9940	0.6176	0.8637	-2.4360	0.970	96.608
		(1.9634)	(4.5867)	(2.1094)	(-2.8015)		
99 Agricultural chemicals	26.4461	0.6687	0.5897	0.4426	-6.9582	0.791	10.413
	(1.1951)	(1.3105)	(3.1436)	(1.6628)	(-1.6547)		
100 Miscellaneous chemical products	-8.3497	1.0802	0.6091	0.1110		0.968	120.532
	(-3.3633)	(3.7806)	(5.3724)	(0.6572)			
101 Petroleum refining		0.3660	0.8311	0.6339	-1.2306	0.877	21.348
		(1.2227)	(4.4903)	(3.2953)	(-2.5403)		
102 Miscellaneous petroleum and coal products	-4.6981	0.4588	0.5573	0.6027		0.631	6.846
	(-0.6588)	(0.6865)	(2.4221)	(1.4294)			
103 Tires and inner tubes	-0.7984	0.8300	0.7545	0.3591	-1.5003	0.939	42.347
	(-0.1001)	(2.4772)	(5.8616)	(1.4628)	(-1.0405)		
104 Rubber products, plastic hose and footwear		0.7227	0.1267			0.642	12.549
		(3.7840)	(0.5478)				
105 Miscellaneous plastics products, nec	-7.0911	1.0073	0.3704	0.3335	-0.0883	0.993	377.167
	(-3.7556)	(4.7715)	(3.6583)	(1.5176)	(-0.1594)		
106 Footwear, except rubber and plastic	-7.3359	1.5880	0.6239	0.0637	-0.9947	0.994	464.276
	(-1.8463)	(4.7381)	(6.8610)	(0.3079)	(-1.7645)		
107 Luggage, handbags, and leather products, nec	-11.5455	1.2226	0.8745	0.6000	-0.2837	0.964	73.105
	(-3.0636)	(3.6852)	(14.0027)	(3.3405)	(-0.5701)		

Notes:

* No import values.

nec = not elsewhere classified.

There are 56 of the 103 estimating equations with R-squared over .900, and 11 equations have R-squared under .500.

t-statistics, at the .10 probability level with 16 degrees of freedom, the critical t value is 1.75.

F distribution, at the .001 probability level with 4 and 11 degrees of freedom, F value is 10.35.

A MODEL OF NEW NONRESIDENTIAL EQUIPMENT INVESTMENT

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Overview

The overall steps taken to estimate new nonresidential business investment, by type were:

(1) A model was derived to estimate total capital stocks on hand, by industry. The model was used to estimate the demand for capital for 53 industries. See Appendix A.

(2) Along with developed annual rates of efficiency loss, the implied new investment, by industry was determined.

(3) Developed investment flows tables to translate the new investment, by industry estimates to new investment, by type of asset. The investment flows table estimated the investment demand for 22 types of nonresidential new equipment. See Appendix B.

I. Capital Stocks, by industry Model

CES production function

The demand for capital was estimated using the first order conditions of a CES (constant elasticity of substitution) production function modified to include a time variable. The time variable is meant to capture disembodied technical change or shifts in the production arising from long term increased efficiencies in the use of inputs.

The basic form

The basic linearly homogeneous production function is:

Equation 1: $Y = f(t, L, K)$

where:

Y	output
L	labor
K	capital
t	time

Model assumptions

The model assumes perfect competition and profit maximization so that:

both factors are indispensable in the production of output,

$$f(0,K) = f(0,L) = 0$$

both marginal products are nonnegative,

$$MP_L = \partial f/\partial L => 0,\ MP_K = \partial f/\partial K => 0$$

and the marginal products are equal to the real factor prices,

$$\partial f/\partial L = w/p,\ \partial f/\partial K = r/p$$

where w, r, and p are the nominal price of labor, capital, and output.

The functional form

The functional form of the capital demand model is:

Equation 2:

$$Y = Ae^{mt}\left[\delta L^{-\beta} + (1-\delta)K^{-\beta}\right]^{-1/\beta}$$

where

Y	output
K	capital
L	labor
A	the efficiency parameter: indicates the state of technology, $A>0$
δ	the distribution parameter: indicates the relative factor shares in the product, $0<\delta<1$
β	the substitution parameter: determines the value of the (constant) elasticity of substitution, $-1<\beta\neq 0$
m	the rate of growth of disembodied technical change
t	time (measured as the year)

The derivation of the capital demand model

Estimating the CES and using the conditions of profit maximization, the marginal product of capital can be written:

$$\frac{\partial Y}{\partial K} = A' e^{gt}\left(\frac{Y}{K}\right)^{1+\beta}$$

where

$$A' = \frac{(1-\delta)}{A^{\beta}}$$

and

$$g = -\beta m.$$

Assuming perfect competition and profit maximization, the marginal product can be set to equal the real rental cost of capital:

$$A\, e^{gt}\left(\frac{Y}{K}\right)^{1+\beta} = \frac{c}{p}$$

where

K	producers capital stocks
Y	industry output

c	rental cost of capital
p	output price

Solving for capital productivity

$$\frac{Y}{K} = \left(A' e^{gt}\right)^{\frac{-1}{\beta+1}} \left(\frac{c}{p}\right)^{\left(\frac{1}{\beta+1}\right)}$$

taking the logs

$$\ln(Y) - \ln(K) = -\frac{1}{\beta+1}\ln(A') - \frac{g}{\beta+1}t + \frac{1}{\beta+1}\ln\left(\frac{c}{p}\right)$$

then solving for capital

$$\ln(K) = \frac{1}{\beta+1}\ln(A') + \frac{g}{\beta+1}t + \ln(Y) - \frac{1}{\beta+1}\ln\left(\frac{c}{p}\right)$$

results in the final basic form of the equation.
The estimated form of the demand for capital equation, derived from the first order conditions under the assumptions of perfect competition is:

Equation 3: $$\ln(K) = a_0 + a_1 t + a_2 \ln Y + a_3 \ln\left(\frac{c}{p}\right)$$

where:

K	capital stocks
c	rental cost of capital
Y	lagged industry output
p	output price
t	time in years
a_{0-3}	coefficients

Note on variables:
Industry output. Because industry output is determined iteratively from the input-output system and the projections for final demand, it was necessary to relax the model assumption of instantaneous capital stock adjustment (this year's capital stocks are based on this year's output). Therefore, the adjustment to capital stocks was assumed to be a function of last year's output.

Rental cost of capital. Definition - estimated current dollar rent on one dollar's worth of constant (1987) dollar stock. The commercial prime rate, derived from the macro model, was used as a proxy to extrapolate the historical cost of capital series.

Industry prices. The forecast of industry prices was derived by extrapolating the industry price index as a function of the GDP price index, which is solved for by the macro model.

Capital stocks, rental cost of capital, and gross new investment. Historical data was derived from the BLS/Office of Productivity and Technology's capital input data that is used as a part of their of productivity measurements.

II. New Investment, by Industry

After the demand for capital stocks was estimated, new investment by industry was derived by subtracting the current year's demand for capital from the demand level from the previous year adjusted for loss of efficiency.

Equation 4: $$I_t = K_t - \delta K_{t-1}$$

where:

I	gross new investment by industry
δ	annual rate of efficiency loss

The historical annual rate of efficiency loss by industry was derived by rearranging the investment function.

Equation 5: $$\delta = \frac{K_t - I_t}{K_{t-1}}$$

A linear extrapolation of the historical annual rate of efficiency loss was then used in the projected period.

III. Investment Flows Tables and National Income and Product Accounts

Investment flows tables, which were developed for the years 1977 through 1994, translates new investment or final demand by 53 industries to 22 types of nonresidential new equipment (NIPAs). Examining the table's rows illustrates the dominate assets that each industry demands. Examining the table's columns illustrates the dominate industries that demand each asset type.
Because the sale of scrap is omitted from the new investment by industry series, there remains a small difference between that series and the NIPAs. To account for this, a scalar series was added to the table and used to derive annual adjusted coefficient tables, whose asset totals equaled the NIPA controls.
The scalar coefficients were computed by taking the difference between the investment by type total, implied by the gross new investment by industry series, and the NIPA totals for each asset type and then dividing that by the sum of the differences between the gross investment series and the NIPAs for all assets.

$$Scaler_j = \left(\frac{\sum I_i - N_j}{\sum I_i - \sum N_j}\right)$$

where:

I	gross new investment by industry
N	new nonessential equipment by type of asset
i	industry (1-53
j	asset types (1-22)

The projected gross investment by industry series was then transposed against the 1994 investment coefficients table to derive the initial projected NIPA controls.

IV. Problems

(1) The historical data obtained from the Office of Productivity and Technology is in 1987 constant, fixed weighted, dollars. Furthermore, the data will not be converted to 1992 constant, chain weighted, dollars until the end of 1997. Therefore, instead of rebasing the entire historical data base, the final new investment by industry estimates were rebased before being translated, via the flows table, to new investment by type of asset. The rebasing ratio formula is as follows:

$$2006\text{: C,1992 \$} = \left(\frac{1992\text{: K,1992 \$}}{1992\text{: C,1987 \$}}\right) * 2006\text{:C,1987\$}$$

(2) Due to time constraints, the lagged projected industry outputs for the capital stocks model was not iteratively derived. Instead, the historical industry output series in 1987 dollars was extrapolated and used as a proxy.

Appendix A: Industry Codes (1987 SIC codes in parentheses)

1 -- Agricultural services, forestry, and fisheries
2 -- Metal mining (10)
3 -- Coal mining (11,12)
4 -- Oil and gas extraction (13)
5 -- Nonmetallic minerals, except fuels (14)
6 -- Construction (15,16,17)
7 -- Lumber and wood products (24)
8 -- Furniture and fixtures (25)
9 -- Stone, clay, and glass products (32)
10 -- Primary Metal Industries (33)
11 -- Fabricated metal products (34)
12 -- Industrial machinery and equipment (35)
13 -- Electronic and other electric equipment (36)
14 -- Transportation equipment, including motor vehicles (37)
15 -- Instruments and related products (38)
16 -- Miscellaneous manufacturing industries (39)
17 -- Food and kindred products (20)
18 -- Tobacco manufactures (21)
19 -- Textile mill products (22)
20 -- Apparel and other textile products (23)
21 -- Paper and allied products (26)
22 -- Printing and publishing (27)
23 -- Chemicals and allied products (28)
24 -- Petroleum and coal products (29)
25 -- Rubber and miscellaneous products (30)
26 -- Leather and leather products (31)
27 -- Railroad transportation (40)
28 -- Local and interurban passenger transit (41)
29 -- Trucking and warehousing (42)
30 -- Water transportation (44)
31 -- Transportation by air (45)
32 -- Pipelines, except natural gas (46)
33 -- Transportation services (47)
34 -- Communications (48)
35 -- Utilities (49)
36 -- Wholes trade (50,51)
37 -- Retail trade (52 - 59)
38 -- Depository institutions (60)
39 -- Non depository institutions (61, 67)
40 -- Security and commodity brokers (62)
41 -- Insurance carriers, agents, brokers, and service
42 -- Real estate (65,66)
43 -- Hotels and other lodging places (70)
44 -- Personal services (72)
45 -- Business services (73)
46 -- Auto repair, services, and parking (75)
47 -- Miscellaneous repair services (76)
48 -- Motion pictures (78)
49 -- Amusement and recreation services (79)
50 -- Health services (80)
51 -- Legal services (81)
52 -- Educational services (82)
53 -- Social services, museums, etc. (83,84,86,87,89)

Appendix B: Final Demand Sectors

1 -- Furniture and fixtures
2 -- Fabricated metal products
3 -- Engines and turbines
4 -- Tractors
5 -- Agricultural machinery, except tractors
6 -- Construction machinery, except tractors
7 -- Mining and oilfield machinery
8 -- Metalworking machinery
9 -- Special industry machinery, n.e.c
10 -- General industrial, including materials handling,
11 -- Office, computing, and accounting machinery
12 -- Service industry machinery
13 -- Electrical transmission, distribution, and industrial apparatus
14 -- Communication equipment
15 -- Electrical equipment, n.e.c.
16 -- Trucks, buses, and truck trailers
17 -- Autos
18 -- Aircraft
19 -- Ships and boats
20 -- Railroad equipment
21 -- Instruments; photocopy and related equipment
22 -- Other nonresidential equipment

Investment model regression results for capital stocks
Output is lagged one year

Industry	Intercept	Year	Indout	Cap cost	T intercep	T year	T indout	T kdivp	R2	F	ndustry
1 Farms	-99.465	0.054	0.268	0.299	-16.263	13.065	1.19	3.167	0.976	436.237	1
2 Metal Mining	-50.347	0.032	-0.531	-0.563	-9.766	11.439	-3.329	-7.332	0.880	78.350	2
3 Coal mining	-75.691	0.046	-0.679	-0.185	-2.54	2.528	-1.038	-1.416	0.723	27.785	3
4 Oil and Gas Extraction	-115.123	0.063	0.108	0.147	-15.346	16.36	0.497	1.473	0.939	164.639	4
5 Nonmetallic Minerals, except fuels	-63.269	0.040	-0.693	-0.067	-13.66	13.294	-3.644	-0.823	0.922	125.963	5
6 Construction	2.328	-0.003	1.119	-0.522	0.413	-0.699	3.652	-4.792	0.708	25.801	6
7 Lumber and wood products	-35.375	0.022	0.054	-0.077	-3.199	3.079	0.175	-0.627	0.803	43.598	7
8 Furniture and fixtures	-99.244	0.059	-0.906	0.069	-8.616	8.48	-3.995	0.598	0.933	148.579	8
9 Stone, clay, and glass products	-37.442	0.020	0.682	-0.033	-5.839	5.083	3.233	-0.521	0.894	89.971	9
10 Primary metal industries	-48.070	0.028	0.297	-0.105	-11.189	12.393	2.984	-2.612	0.945	183.879	10
11 Fabricated Metal Products	-90.964	0.052	-0.116	0.059	-20.708	18.171	-0.893	0.655	0.980	512.726	11
12 Industrial machinery and equipment	-93.344	0.054	-0.191	-0.013	-3.838	3.876	-0.671	-0.108	0.939	164.731	12
13 Electronic and other electrical equip	-265.223	0.148	-1.485	0.567	-7.859	7.677	-3.789	2.76	0.947	191.373	13
14 Transportation equipment, inc. motor	-77.185	0.042	0.421	0.069	-16.343	14.349	3.936	1.49	0.986	738.702	14
15 Instruments and related products	-218.173	0.118	-0.603	0.226	-6.006	5.79	-1.633	1.244	0.975	421.605	15
16 Misc. manufacturing industries	-57.326	0.034	-0.213	-0.027	-12.332	11.985	-1.756	-0.356	0.947	191.762	16
17 Food and kindered products	-88.940	0.064	-2.128	0.105	-7.281	7.359	-5.33	1.589	0.938	162.226	17
18 Tobacco manufactures	-83.317	0.050	-0.802	-0.110	-13.255	21.152	-2.155	-1.007	0.941	169.869	18
19 Textile mill products	-20.987	0.019	-0.556	-0.134	-4.388	6.2	-3.761	-1.483	0.594	15.597	19
20 Apparel and other textile products	-102.014	0.055	0.067	-1.189	-5.162	4.465	0.133	-4.429	0.833	53.299	20
21 Paper and allied products	-115.206	0.066	-0.460	0.298	-12.651	11.829	-2.549	4.136	0.984	634.848	21
22 Printing and publishing	-37.950	0.021	0.463	-0.494	-2.768	2.518	1.689	-5.07	0.983	596.887	22
23 Chemicals and allied products	-114.765	0.066	-0.430	0.121	-24.537	24.011	-6.162	2.543	0.992	1399.503	23
24 Petroleum and coai products	-137.163	0.084	-1.684	0.167	-9.922	9.767	-5.559	2.078	0.915	115.217	24
25 Rubber and misc. plastics products	-113.104	0.063	-0.144	-0.140	-17.423	16.926	-1.814	-2.601	0.994	1710.162	25
26 Leather and leather products	-4.345	0.004	0.406	0.126	-0.501	1.054	2.18	1.204	0.556	13.362	26
27 Railroad transportation	10.506	0.000	-0.034	-0.372	1.145	0.042	-0.116	-4.42	0.744	30.996	27
28 Local and interurban passenger tran	22.409	-0.003	-0.851	-0.293	4.974	-1.6	-3.383	-1.393	0.338	5.444	28
29 Trucking and warehousing	-82.506	0.048	-0.160	0.004	-2.895	2.837	-0.369	0.04	0.936	156.644	29
30 Water transportation	-13.270	0.012	-0.034	-0.301	-2.898	4.418	-0.256	-2.902	0.504	10.846	30
31 Transportation by air	-79.466	0.042	0.613	-0.271	-5.794	5.547	4.866	-3.095	0.969	334.457	31
32 Pipelines, exc. natural gas	120.796	-0.071	2.931	-1.343	6.143	-6.321	8.643	-8.247	0.807	44.647	32
33 Transportation services	-102.245	0.058	-0.308	0.178	-5.347	5.576	-1.899	2.595	0.925	131.533	33
34 Commmunications	-80.777	0.042	0.726	0.007	-3.458	3.238	3.385	0.087	0.991	1221.363	34
35 Utilities	-129.979	0.071	0.037	0.315	-24.79	22.901	0.39	4.403	0.990	1011.381	35
36 Wholesale trade	-198.700	0.114	-1.218	-0.753	-2.278	2.248	-1.179	-1.517	0.953	217.685	36
37 Retail trade	-250.346	0.147	-2.196	1.001	-7.032	6.669	-3.365	2.892	0.941	170.683	37
38 Depository institutions	-428.910	0.237	-2.518	-1.237	-4.45	4.367	-2.59	-3.051	0.966	301.465	38
39 Non depository institutions	-127.820	0.066	0.796	-0.183	-2.148	2.088	2.627	-0.461	0.944	178.907	39
40 Security and commodity brokers	-119.303	0.058	1.083	0.055	-1.532	1.45	4.487	0.107	0.839	55.618	40

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Investment model regression results for capital stocks.
Output is lagged one year.

41 Insurance carriers, agents, brokers	-349.013	0.208	-4.601	-1.342	-1.851	1.883	-1.709	-3.231	0.797	41.918	41
42 Real estate	-287.113	0.165	-2.246	0.605	-7.402	7.137	-4.055	2.214	0.957	237.773	42
43 Hotels	-73.809	0.034	1.356	-0.338	-3.884	3.158	5.458	-2.027	0.988	907.911	43
44 Personal services	-87.069	0.041	1.367	-0.178	-4.872	3.979	3.737	-0.705	0.968	325.846	44
45 Business services	-276.246	0.146	-0.226	0.019	-10.632	10.928	-2.039	0.059	0.986	747.587	45
46 Auto repair, services, and parking	-185.185	0.095	0.623	0.757	-10.368	9.461	2.951	4.579	0.985	682.146	46
47 Misc. repair services	-132.637	0.069	0.378	0.144	-16.474	14.123	1.778	1.276	0.969	331.141	47
48 Motion pictures	-179.053	0.091	0.636	0.223	-12.022	11.526	5.002	1.23	0.986	775.229	48
49 Amusement and recreation services	23.908	-0.015	1.488	-0.750	1.017	-1.15	4.83	-10.98	0.956	230.079	49
50 Health services	-338.024	0.187	-1.782	0.234	-5.716	5.633	-3.276	0.563	0.971	355.248	50
51 Legal services	110.388	-0.070	3.260	-0.254	0.599	-0.678	1.613	-0.365	0.699	24.752	51
52 Educational services	-302.697	0.163	-1.356	1.615	-5.924	5.72	-2.363	7.142	0.750	31.909	52
53 Social services, museums, mem. org	-513.017	0.278	-2.448	1.426	-8.689	8.547	-4.763	4.108	0.936	155.529	53

GLOBAL FORECASTING AND FORESIGHT

Chair: Kenneth W. Hunter
World Future Society

Global Forecasting and Foresight (Abstract),
Kenneth W. Hunter, World Future Society

Global Forecasting and Foresight

Chair: Kenneth W. Hunter
World Future Society

Professional futures researchers are currently initiating an examination of the theories, methods and practices that comprise the foundation of global futures research, education, and policy advising. Forecasting and defining policy and planning assumptions for several decades ahead is a critical component of futures research. In addition, new initiatives for collaborative futures programs in major policy areas and for international and domestic regions are driving the need to strengthen the core capacity for integrating knowledge and models, baselines and assumptions, research agendas, and collaborative research support systems. This panel will discuss several of the new programs and initiatives in the area of futures research.

Panelists:

Kenneth W. Hunter
World Future Society's 1999 Conference "Frontiers of the 21st Century" and President, Collaborative Futures International

Dennis Pirages
Director, The Harrison Program on the Future Global Agenda, University of Maryland, College Park

Paul J. Runci
Research Scientist, Battelle Pacific Northwest National Laboratory, Richland, Washington

Jerome C. Glenn
Executive Director, Millennium Project, United Nations University

COMMUNITY POLICY MODELS

Chair: James K. Scott
Community Policy Analysis Center
University of Missouri - Columbia

The Impact of Medicare Capitation Payment Reform: A Simulation Analysis,
Timothy D. McBride et al., University of Missouri - St. Louis

Community Policy Analysis System (ComPAS),
Thomas G. Johnson and James K. Scott, Rural Policy Institute,
University of Missouri - Columbia

Projections of Regional Economic and Demographic Impacts of Federal Policies,
Glenn L. Nelson
Rural Policy Research Institute, University of Missouri - Columbia

The Impact of Medicare Capitation Payment Reform: A Simulation Analysis

September 1997

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On August 5, 1997, President Clinton signed H.R. 2015, the Balanced Budget Act of 1997. This legislation includes changes in the Medicare payment methodology used to determine monthly, per member payments to health plans participating in risk contracts, typically entered into by Health Maintenance Organizations (HMOs). Currently, the basis for calculating current payment under "risk contracts" is an average of previous expenditures in fee for service payments received by Medicare beneficiaries in each county. The county-specific approach to calculating capitation results in large variation in rates across counties and large volatility in payment annually in counties with small enrollment, contributing to lower penetration in those counties and to the financial instability of the Medicare program.

This paper uses simulations to project the impact of the legislation on payments that will be available for health plans in all counties. This paper describes the problems with the current methodology and provides details of the methodology used in these simulations. Finally, the paper describes the final legislative changes and outlines key findings from the simulations.

I. WHAT IS THE PROBLEM WITH THE CURRENT AAPCC METHODOLOGY?

The increased use of managed care by private insurance plans, and coterminous restraint in premium charges, has intrigued public policy makers. As a result, managed care is touted as a means of controlling spending in the Medicaid and Medicare programs. While enrollment in managed care by Medicare beneficiaries has increased considerably in recent years, it remains quite low in rural areas. In 1996, only 1.4 percent of rural (nonmetropolitan) Medicare beneficiaries were enrolled in HMOs, as compared to 14 percent in urban (metropolitan) areas.

The relatively low adjusted average per capita cost (AAPCC) rates paid in many rural counties as compared to urban counties, and the volatility in these rates from year to year, are often cited as the primary reasons for lower rates of Medicare risk-plan enrollment rates in rural areas of the country (Dowd, Feldman, and Christianson, 1996; Serrato, Brown, and Bergeron, 1995). The current rate for "risk contracts" in Medicareis set at 95 percent of the AAPCC rate in the county where the beneficiary lives, with adjustments made for a few selected enrollee characteristics. The rate is based on historical expenditures in each county, and therefore is lower in rural areas because it reflects (a) historical inequities in Medicare reimbursement rates, and (b) lower health care utilization in rural areas. In addition the small size of rural counties contributes to variation and volatility in rates across counties and over time.

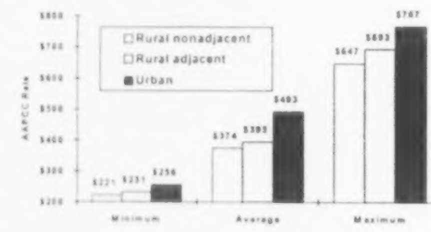
Variation in AAPCC rates. Attention for years has focused on the substantial variation in AAPCC rates across counties in the US. As shown in Figure 1, rates varied from an extreme low of $221 in two rural counties in Nebraska (Banner and Arthur) to an extreme high of $767 in Richmond county, New York. Although the overall average rate was $467 in 1997, the lowest rates were found in rural counties and the average AAPCC rate in rural counties not adjacent to urban counties was only $374, as compared to $395 in rural counties adjacent to urban counties, and $493 in urban counties in the US.

The lower rates in some counties, especially rural counties, is largely attributable to the methods used to construct AAPCC rates. The rate is based on actual historical expenditures in each county, and therefore is lower in rural areas because it reflects (a) lower medical care prices, especially historical inequities in Medicare reimbursement rates, and (b) lower health care utilization in rural areas.

First, it is well known that the prices of some goods and services are lower in rural areas, such as rent and housing prices. In addition, medical care prices are likely to be lower especially because of the historical structure of reimbursement in the Medicare system, which built in inequities against rural areas. Since these reimbursement rates are currently used to reimburse providers under the Medicare fee-for-service system, and AAPCC rates are based on historical Medicare FFS spending, the AAPCC rates will reflect these lower prices.

Figure 1.
Variation in Medicare AAPCC Rate, by county location, 1997

Significant variation in AAPCC rates across "place"



Second, AAPCC rates are lower, especially in rural areas, due to a historically lower use of medical services in rural areas. There may be many reasons for these differences, but this difference is likely attributable in large part to the historical access problems in rural areas, especially a lower physician/population ratio and low availability of other medical care services.

The small size of many rural counties exacerbates these two problems. In particular, since AAPCC rates are based on a five-year historical average of utilization in the county, the increased service use of only a few beneficiaries could have a huge impact on AAPCC rates. To cite an extreme example, Loving county in Texas has only 19 Medicare enrollees. Thus an increase in consumption of Medicare services of only $10,000 by only one beneficiary (easily the bill for an inpatient hospital episode) would increase rates in the county by over $100 per month once that medical bill was averaged over 19 beneficiaries and five years.

It is largely believed that basing reimbursement to Medicare HMOs on historical prices and utilization is inequitable to rural areas for two main reasons. To the extent that price differences measure true differences in the cost of living in rural as opposed to urban areas, then some difference in reimbursement rates is justified. However, to the extent that the structure of Medicare's FFS reimbursement system exaggerated these differences, these price differentials are less justified. Second, differences in AAPCC rates that reflect lack of access to services "lock in" historical access problems.

Variation

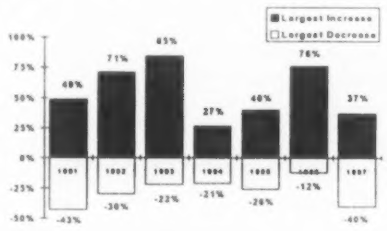
Definition. The difference between Medicare AAPCC and capitation rates across counties.
Statistical definition. Variation in capitation rates across time can be most simply described by a single number: the ratio of (a) the standard deviation of capitation rates in the U.S. to (b) the mean capitation rate in the US. This is a standard measure of "variation" used by statisticians.
Variation in current rates. In 1997, the average variation in AAPCC rates across the US was 21.4 percent. This means that the average difference (higher or lower) between a county's AAPCC rate and the national average of AAPCC rates was roughly 21 percent.
Illustrative Example. In 1997, AAPCC rates varied from an extreme of $767 in Richmond (NY) to $221 in two counties in Nebraska (Banner and Arthur). Since the average

Table 1 shows that the variation in rates acros the U.S. has been increasing over time, with variatio measured by the average difference between the county rates and the average AAPCC rate in the U.S. (see box). From 1990 to 1997, the variation in AAPCC rates increased from 17.7 percent to 19.4 percent, indicating that the problems with the AAPCC methodology are getting worse over time.

Volatility in AAPCC rates. An issue that has not received as much attention from researchers and policymakers is the volatility in AAPCC rates over time. But in a 1986 survey of Medicare HMOs, 86 percent of respondents contended that AAPCC payment levels within counties were unpredictable (Brown et al. 1993). Moreover, the year to year volatility in AAPCC interfered with the ability of the HMO to anticipate revenue flows and plan effectively. Because health plans serving counties with volatile rates face greater uncertainty regarding payment rates for future years, they may be less willing to enter the market with a Medicare risk-contract product (PPRC, 1996).

Figure 2.
Volatility in AAPCC Rates, 1990-97

AAPCC rates are volatile



Source: McBride, Penrod and Mueller (1997).

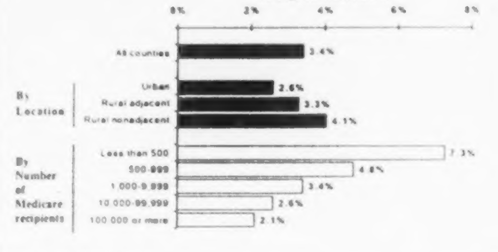
Over the 1990-97 period, the volatility in AAPCC rates was considerable. The year-to-year changes in rates were often dramatic. For example, in 1997 one county experienced a 37 percent increase in their AAPCC rate, while another county experienced a dramatic 40 percent drop in their rate (Figure 2). Over the 1990-97 period, the steepest increase in rates was an 85 percent increase observed in 1993 and a 43 percent drop witnessed in 1991.

While these extreme cases are illustrative of the dramatic volatility that can occur under the AAPCC methodology, of course most counties do not experience volatility to the extent illustrated here. Using a measure of volatility across counties (see box), the average volatility experienced in the 1990-97 amounted to 3.4

percent, indicating that in the 1990-97 period the average change in rates (positive or negative) over and above the growth in national average Medicare spending was 3.4 percent annually. Table 2 shows that the local volatility in AAPCC rates was greater in rural adjacent counties (3.3 percent) and rural nonadjacent counties (4.1 percent) than it was in urban counties (2.6 percent). These results support the intuition that AAPCC rates will be more volatile in rural areas because of the smaller populations in these areas, because a few high cost procedures or patients could have a large influence on the AAPCC rate in any given year.

Figure 3.
Volatility in AAPCC rates by size and location of county, 1990-97

Volatility in rates is highest in areas with low population



Source: McBride, Penrod and Mueller (1997)

Figure 3 also presents counties differentiated by other important characteristics that might be likely to vary with volatility at the local level. Given that volatility is likely to be higher in counties with a smaller number of Medicare beneficiaries, it is not surprising that volatility is higher in counties with less than 500 Medicare eligibles (volatility of 7.3 percent) as compared to larger counties, especially counties with more than 100,000 Medicare beneficiaries (2.1 percent). Volatility also seems to be related to the risk plan penetration rate (enrollees in Medicare risk plans as a ratio to total Medicare beneficiaries) in the county, since volatility is higher in counties with no Medicare risk enrollment (4.4 percent) than it is in counties with considerable risk enrollment (2.4 percent) (Table 2). Finally, the results also indicate that volatility is highest in counties with the lowest AAPCC rates in 1997. The main source of volatility in a county's AAPCC rate is fluctuations in service use patterns because AAPCC are based on the five years of recent historical expenditures in the county for recipients not enrolled in health maintenance organizations. Thus, the AAPCC rate is a function of utilization and prices, both of which have been lower in rural counties, the latter a function of recent Medicare reimbursement policies. Consequently, the problem of volatility may be exaggerated in rural

Volatility

Definition. The year to year fluctuation in capitation rates across counties.
Statistical definition. Volatility of capitation rates over time is defined as the absolute value of (a) the annual growth in the capitation rates for a year less (b) the growth rate in per capita national average Medicare spending across the U.S. (see McBride, Penrod, Mueller, 1997, for a full description of this measure). This measure is based on the reasoning that an HMO should reasonably expect rates at the local level to keep pace with national average per capita spending on Medicare and that any increase above or below that is "local volatility." Since capitation rates may not grow as fast as the growth in Medicare spending per capita in many counties -- and a Medicare risk plan may be as concerned about uncertainty on either the positive or negative side -- what is presented here is the average of the absolute value of growth.
Recent volatility. Between 1990 and 1997, volatility is AAPCC rates across the US averaged 3.4 percent, indicating that the average change (positive or negative) in AAPCC rates, over and above the change in national average per capita Medicare spending was 3.4 percent (Table 2).
Illustrative Example. To illustrate this method, suppose a county has a capitation rate of $300 in 1997 and the capitation rate rises to $330 in 1998, an increase of 10 percent. Suppose also that the growth in per capita national average Medicare spending was 5 percent in 1997. Based on these data, the total growth in capitation rates in this county would be 10 percent, 5 percent due to national Medicare per capita spending growth, and 5 percent due to "volatility" at the local level.
Counties with volatility. The county that experienced the most volatility in rates over the 1990-97 period was Loving county (TX), where the AAPCC rates over the 1990-97 period were: $293, $254, $434, $378, $443, $501, $881 $527.

areas because fluctuations in service use patterns tend to be larger for areas with small Medicare populations (McBride, Penrod, Mueller, 1997; PPRC, 1997).

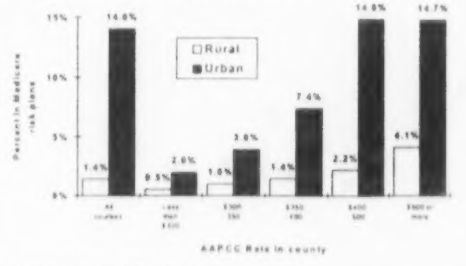
Implications of variation and volatility

While it is quite clear that the methods used to compute local area AAPCC rates lead to substantial variation and volatility, this is not by itself indicative of the effects of these problems on health systems across the U.S. Instead, the major impetus for reform of the AAPCC rate-setting methodology stems from the conclusion that variable and volatile AAPCC rates have contributed to several problems:

- **Managed care penetration is low in counties with lowest AAPCC rates.** It is logical that Medicare risk plans would be more reluctant to offer plans in areas where AAPCC rates are low and volatile. The evidence bears out a strong relationship. For example, while enrollment in Medicare risk plans exceeded 14 percent in urban areas with rates above $400 in 1996, enrollment was only 2 percent in urban areas with AAPCC rates below $300 and 0.5 percent in rural areas (Figure 4). Overall, rural enrollment in Medicare risk plans was only 1.4 percent in 1996. However, enrollment rates only reached 4.1 percent in rural areas with AAPCC rates exceeding $500, indicating that even higher AAPCC do not guarantee significantly higher risk plan enrollment. Nevertheless these data do suggest that lower and more volatile AAPCC rates have inhibited the growth of managed care in rural areas, and inhibited the pace of health market reform in those areas.

Figure 4.
Medicare Risk Plan Enrollment and AAPCC Rate, 1996

Low rates contribute to low risk plan penetration



- **Inequity in benefits offered across counties.** Under HCFA regulations, risk plans are required to submit cost reports that estimate the cost of providing benefits to Medicare recipients in managed care. If the payments received by the plan exceeds these costs, then the plan has two options: offer more benefits to recipients or return the difference to HCFA. To date, all plans have chosen the first option of offering more benefits to recipients. For example, 62 percent of risk plans in the US offer prescription drug coverage, 97 percent offer routine physicials, 74 percent offer hearing exams, and 38 percent offer dental benefits to cite just a few examples (PPRC, 1997, Figure 2-14). In addition, 65 percent provide all their extra benefits without charging an additional premium to recipients and many plans reduce or eliminate out of pocket copayments and deductibles.

  The evidence shows that plans located in areas that receive much lower AAPCC rates are much less likely to offer enhanced benefits (PPRC, 1996; PPRC, 1997). Thus, the large variation in rates across counties contributes to inequities in benefits available, especially for rural residents. Most rural Medicare recipients are not enrolled in managed care and those who are enrolled will not have extra benefits available to them. This inequity is considered to be unfair by many Medicare recipients aware of the problem.

- **AAPCC policies contribute to Medicare financial problems.** Originally Medicare managed care was devised as a strategy for reducing and stabilizing the growth in Medicare expenditures. However, most analysts have concluded that the Medicare risk program has increased Medicare spending. This largely results from two phenomena. First, as described above, when the costs of plans are well below the payment received from HCFA, the difference is not returned to HCFA, thus resulting in additional aggregate expenditures. Second, a series of studies provide evidence to support the proposition that Medicare risk plan participants are healthier than Medicare fee-for-service recipients (described as "favorably selected"), but plans are still compensated according to average Medicare FFS spending through the AAPCC formula

(PPRC, 1997). Thus favorable selection contributes to increases in Medicare spending.

- **Policies contribute to inadequate Medicare reimbursement rates in rural areas.** Since Medicare risk plans have actually led to an increase in Medicare spending, risk plans have actually contributed to the financial problems facing Medicare. Over the years, the major response by Congress to financial problems in Medicare has been to reduce the growth in reimbursement rates for providers, especially hospitals and physicians. Thus the problems with the AAPCC methodology described above have contributed to continued restraint on the growth of reimbursement rates for rural providers and have impeded efforts to reduce inequity in rates.

II. DESCRIPTION OF PROVISIONS TO REFORM AAPCC METHODOLOGY

On August 5, 1997, President Clinton signed H.R. 2015, the Balanced Budget Act of 1997. Table 3 presents an outline of the change considered here. As indicated in the table, the adjusted capitation rate in a given year would be equal to the greater of:

(I) a **blended capitation rate,**[1] determined as the weighted average of the area-specific adjusted capitation rate (ASACR) and the input-price-adjusted national adjusted capitation rate (IPANACR) phased in over six years until rates are based on a 50%/50% average of the ASACR and IPANACR rates,

(ii) a **floor,** initially set at $367 in 1998 and indexed for Medicare per capita spending growth thereafter, and

(iii) a **hold harmless** rate, set at 102 percent of the area's adjusted capitation rate in the previous year.

While this formula seems complicated, essentially it sets the new capitation rate at the blended rate, although the capitation rate is not allowed to fall below the payment "floor" or a "hold harmless" rate.

The provision for blending the capitation rates is designed to achieve the objective of equalizing capitation rates across counties, since this method uses the area-specific capitation rate (ASACR) and averages it with the input-price-adjusted national adjusted capitation rate (IPANACR). The ASACR is based on the previous AAPCC rates in the county. The IPANACR is essentially based on the average of AAPCC rates across the US (called the USPCC, the United States per capita cost), adjusted to reflect variations in local prices across counties. Adjusting rates for local prices is done in the realization that the prices facing managed care organizations vary across areas. The price index for computing the IPANACR is specified in the legislation and constructed using price indices computed by HCFA to set reimbursement rates for hospitals and physicians.

To calculate the blended capitation rate, each piece of legislation uses an "area-specific percentage" (ASP) to weight the ASACR and a "national percentage" (NP) to weight the IPANACR. Since essentially AAPCC rates under current law are based on 100 percent of the area-specific rate, these percentages are phased in over time, until the applicable percentages are reached in 2002. The ASP is set at 50 percent in the year 2003 and phased in over the 1998-2003 period, set at 90, 82, 74, 66, 58 and 50 percent in those six years.

The floor is also used to equalize capitation rates across counties and is used to reflect the realization that historical prices and utilization may be so low that it would not be possible for any managed care organization to operate in a local area if the capitation rate fell too low. Thus, the floor is designed to guarantee that each county has a capitation rate that would make MCOs viable in that area. The hold harmless provision is designed as a protection against fluctuations in capitation rates, guarantee that the growth in capitation rates is at least 2 percent in future years.

In each year, the ASACR and IPANACR will be increased by the national average per capita growth percentage (NAPCGP), basically the average national increase in per capita Medicare spending, less some specified percentages in the period 1998 through 2001. In 1998, 0.8 percentage points are subtracted from the growth rate, while 0.5 percentage points are subtracted from the growth rate in the period 199 through 2001. This provision is important because it guarantees that rates in the future will increase a steady and predictable rate, thus removing the year-to-year volatility that has been witnessed in previous years.

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[1] Note the terminology "blended capitation rate" is the term used to describe this method in the literature (PPRC, 1996; PPRC and ProPAC, 1995), but not typically in any of the proposed legislation.

A "budget neutrality adjustment" (BNA) is used in all pieces of legislation to insure that the aggregate payments made under the proposed policies shall be equal to the aggregate payments that would have been made if the rates had been calculated with the area-specific percentage (ASP) set equal to 100 percent. In other words, total expenditures under these provisions are not allowed to exceed what would have been paid if every county was paid their area-specific rate and no county was affected by provisions such as the floor and blended rates. If the budget neutrality provision is triggered, it is used only to adjust blended capitation rates. For example, if expenditures under the proposed legislation exceed expenditures that would have been made otherwise by 5 percent, then blended rates would be reduced by 5 percent.

The legislation reduces local area capitation rates (the ASACR) for the amount of spending made in the county for the graduate medical education (GME) programs. This program pays hospitals for expenditures incurred for education of medical residents. Since these expenditures are included in the payments to hospitals under the fee-for-service portion of the Medicare program, these payments will implicitly be included in the calculation of AAPCC payments. This is considered to be a problem since the AAPCC payments are made not to hospitals, but to managed care organizations. Thus, the payments designed to help defray education expenditures may never reach the hospital. In H.R. 2015, GME expenditures are carved out from the capitation rates over a five year period with 20, 40, 60, 80, and 100 percent of GME spending carved out in the years 1998 through 2002, respectively.

From this summary, several provisions are important in the eventual setting of capitation rates across counties. Key factors in the determination of the new Medicare capitation rates are the percentages used in the blended rates, the methods used to set the floor, the carving out of GME payments, and the use of standardized predictable growth rates in the setting of future capitation rates.

III. SIMULATION METHODS AND DATA

The Rural Policy Research Institute (RUPRI) Health Panel has constructed a comprehensive data set and simulation model that is used to simulate the effects of the policy changes described here. This file, called the RUPRI Medicare Capitation County Data File, was constructed by merging data from several sources, but primarily from obtained from the Health Care Financing Administration (HCFA). The file contains over 1,300 variables that generally fall into the following categories:

- Historical AAPCC rates, 1990-97
- Medicare enrollment in county, 1996
- Number of enrollees in Medicare HMOs, 1996
    - including details on enrollment by each plan enrolling in the county
- Number of Medicare HMO plans with Medicare enrollees enrolled in the plan by county (includes distinction for whether plan includes county in its Geographic Service Area)
- Characteristics of Medicare risk plans offered in the county. For each plan data includes:
    - Name and location of plan
    - Dates of HCFA contract
    - Type of plan (risk, demo, or cost)
    - Type of HMO (staff, group or IPA)
    - Profit/non-profit status of plan
    - Benefits offered by plan (e.g., preventive, dental, eye, ear, drugs)
    - Premium charged by plan
- County share of Graduate Medical Education (GME) and Disproportionate Share (DSH) spending
- An "input price adjustment" for the county, based on the formula described below
- County descriptive variables (Beale codes, population, population in poverty)

In general, most of this data was originally obtained from the Health Care Financing Administration, from files available on the Internet. However, additional data was obtained directly from other HCFA offices, specifically the Office of the Actuary and the Office of Managed Care. Finally, additional data was obtained from the 1990 Census, the Economic Research Service and the Federal Register.

The data from each of these sources was merged at the county-level using the county FIPS code and the county name (since FIPS code was not available for the HCFA data). There is not a one-to-one correspondence between the FIPS county code and the code assigned by HCFA. However, mismatches were corrected in all cases, except for Alaska counties. Due to incompatibilities between the HCFA and FIPS classifications, all Alaska counties were dropped from the analysis. Data from U.S. territories (Guam, Puerto Rico, Virgin Islands) was also dropped from the analysis.

The file containing "input price adjustments" (IPA) was computed at the local level by the RUPRI Health Panel by inputting data on Medicare Prospective Payment System (PPS) rates and Resource Based Relative Value System (RBRVS) rates reported at the county level in the Federal Register (Federal Register, 1996). The IPA was computed according to the formula specified in legislation dealing with this issue. In particular, the legislation specifies, in part: *"Medicare services shall be divided into 2 types of services: part A services and part B services.... The proportions...for part A services shall be the ratio (expressed as a percentage) of the national average annual per capita rate of payment for part A for 1997 to the total national average annual per capita rate of payment for parts A and B for 1997, and for part B services shall be 100 percent minus the Part A ratio.... For part A services, 70 percent of payments attributable to such services shall be adjusted by the index used under section 1886(d)(3)(E) to adjust payment rates for relative hospital wage levels for hospitals located in the payment area involved; for part B services, 66 percent of payments attributable to such services shall be adjusted by the index of the geographic area factors under section 1848(e) used to adjust payment rates for physicians' services furnished in the payment area, and of the remaining 34 percent of the amount of such payments, 40 percent shall be adjusted by the index [for relative hospital wage levels]."* (Source: 1997 Balanced Budget Act, HR 2015).

As noted above, H.R. 2015 specifies the use of a "budget neutrality adjustment" (BNA) to insure that the aggregate of the payments under shall be no greater than the aggregate payments that would have been made if the previous AAPCC-based methodology were continued. The budget neutrality adjustment (BNA) was computed by aggregating expenditures for risk enrollees across counties using the multiple of (a) capitation rates that would exist in absence of the legislation (i.e., 100 percent of the area-specific capitation rates) and the (b) enrollment in Medicare risk plans. Then the BNA was computed as equal to:

BNA = [Spending using area-specific rates]/
[Spending using new legislated rates]

As specified in the legislation, this BNA is applied to the capitation rates if the BNA is less than one in the definition defined above. I reality, it has been found that the BNA would not be triggered under any of the legislation proposed to date because the legislation has the effect of lowering rates, relative to the area-specific rates, in counties with high HMO enrollment.

Assumptions are made about several key factors in the determination of the new Medicare capitation rates under proposed policies. These include the determination of the BNA, the national average per capita growth percentage (NAPCGP), and the determination of the input-price-adjusted national adjusted capitation rate (IPANACR). In particular, the IPANACR would be used directly in the formula for a Medicare area, both in the blended capitation rate and often in the "floor," set at some percentage of the IPANACR. Thus, important assumptions had to be made about:

(a) growth in the "national average per capita growth percentage" and "area-specific capitation rates." Recent Congressional Budget Office (CBO) estimates of the growth in Medicare spending were used for this purpose (CBO, 1997a), and

(b) growth in the Consumer Price Index (CPI). CBO estimates (CBO, 1997b) were also used to compute projected increases in the CPI, to use in computing the value of capitation rates in "constant dollars."

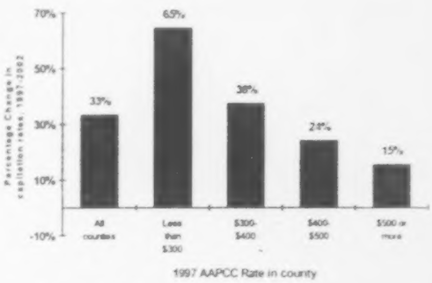
Some assumptions have to be made in the simulations due to the uncertainty about the future. Actual Medicare risk plan enrollment in December of 1996 is used to determine aggregate spending under policy provisions, especially when computing the budget neutrality adjustment (BNA). In reality, actual enrollment in the future will be used for this purpose. Actual enrollment in risk plans in the future is likely to be much higher than enrollment in 1996. However, the growth in enrollment will not affect the estimates here unless the growth in enrollment is radically different across counties.

IV. SIMULATION RESULTS

Tables 4 through 8 summarize the detail of the simulation results. Table 4 presents descriptive statistics summarizing the effects of the proposals on various measures including the mean or average capitation rates and the lowest or minimum capitation rate found in any county. In addition, the tables present measures of the average variation in rates across counties and the average volatility in rates across time since, as indicated above, most analysts have concluded that the variation and volatility in AAPCC rates are the biggest problems with the current methodology for setting rates. Finally the table presents the percentage of counties that would have capitation rates set by the provision setting a "floor" on capitation rates and the percentage of Medicare eligibles residing in counties that would receive the floor.

Under the new legislation, average capitation rates would increase over time, as would be expected since Medicare spending is rising over time. However, the growth in average capitation rates masks important changes in the legislation. The key change in the new legislation occurs because of the reduction in variation and volatility and in comparisons of growth rates across counties.

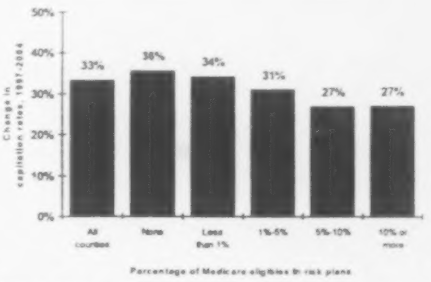
Figure 5.
**Change in Capitation Rates:
By Current AAPCC Rate**



Source: Rural Policy Research Institute (RUPRI) Health Panel

Figure 5 shows that growth rates in capitation rates will be much higher in areas with currently low AAPCC rates than they will be in areas with currently high AAPCC rates. For instance, the growth rate in capitation rates in counties with AAPCC rates currently below $300 will be about 65 percent in the 1998-2004 period (38 percent when adjusted for the rate of price inflation, see Table 6), while capitation rates will grow only 15 percent in counties with rates exceeding $500 per month in 1997 (and experience a negative growth rate of 3 percent when adjusted for price inflation). This vast difference in growth rates obviously reflects the significant features in the proposals designed to "equalize" rates, including the blending of local and national rates, the floor, the averaging of area-specific rates, and the carve out of GME spending.

Figure 6.
**Change in Capitation Rates:
By Medicare Risk Plan Penetration Rate**

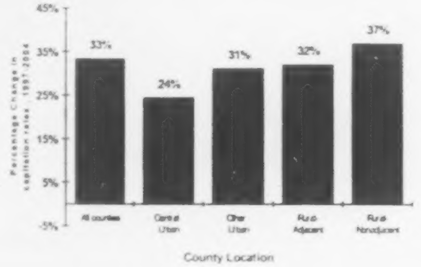


Source: Rural Policy Research Institute (RUPRI) Health Panel

Since one goal of reforming the Medicare capitation payment policy is to encourage growth in Medicare managed care plans, areas with currently low managed care penetration rates will need to experience dramatic growth in capitation rates to encourage plans to offer plans to enrollees. Figure 6 shows that the proposed policy changes will lead to faster growth in capitation rates in the areas with the lowest managed care penetration, with growth rates in the areas with less than no HMO penetration expecting growth exceeding 35 percent, but only 27 percent growth in areas with risk plan penetration exceeding 10 percent. It remains to be seen whether this growth rate differential is large enough to encourage plans now aggressively offering plans in some areas to pursue managed care growth in areas with low penetration.

Effect on Rural and Urban counties. The tables present the simulation results separately for urban (metropolitan) and rural (nonmetropolitan) counties. Since counties with low rates today are most likely to be rural counties, it is not surprising that the average growth in capitation rates will be highest in rural counties, especially rural nonadjacent counties. For example, the growth in capitation rates in rural nonadjacent areas is projected to be more than 50 percent higher than the growth in urban areas (Table 6). However, it is worth noting that difference in growth rates displayed in Figure 7 is not nearly as large as the difference in rates displayed in Figure 6, reflecting the fact that some urban counties have low AAPCC rates, and some rural counties have higher AAPCC rates.

Figure 7.
**Change in Capitation Rates:
By Rural-Urban Location**

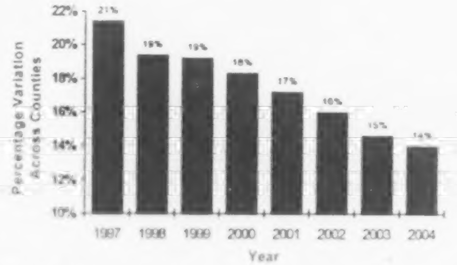


Source: Rural Policy Research Institute (RUPRI) Health Panel

Effect on variation and volatility. All of the proposals significantly reduce volatility and variation in capitation rates. In particular, the variation in rates is equal to roughly 21 percent in 1997, indicating that the average difference between a county's AAPCC rate and the national average rate is 21 percent (higher or lower). The new legislation will reduce this variation significantly (Figure 8). By the year 2004, the variation is reduced to about 14 percent. Table 7 illustrates the reduced variation in another way, showing the percentage of counties distributed by the ratio of a county's capitation rate to the national average rate.

Figure 8.

Impact on Variation in Capitation Rates



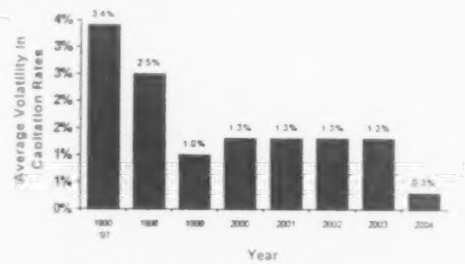
Source: Rural Policy Research Institute (RUPRI) Health Panel

By design, the new legislation reduces significantly the year-to-year volatility in AAPCC rates. This is mostly achieved by basing the growth in capitation rates on the growth in national average per capita Medicare spending (slightly lowered by specified amounts). The results indicate that volatility, which was 3.4 percent in the 1990-97 period, would be reduced to only 1.3 percent under most proposals by the year 2003 (Figure 9). This measure of volatility indicates the average change in a county's capitation rate would exceed (or be less than) the growth in national average per capita Medicare spending by only 1.3 by the year 2003. By the year 2004, after all the provisions are phased in, volatility in rates almost completely disappears, because the future increases in rates would be based on growth in national rates, and because the effects of the transitions built into current policies would have been completed by this time.

Figure 9.

Impact on Volatility in Capitation Rates

Volatility in Rates is Reduced Significantly



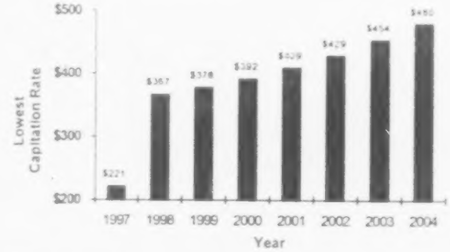
Source: Rural Policy Research Institute (RUPRI) Health Panel

Counties at floor. A "floor" on the capitation rate is important in the short run and is the most important provision for counties with the lowest rate in 1997. In some counties, the blended rates are so low that they will fall below a "floor" set initially at $367, and adjusted for growth in Medicare spending thereafter (Figure 10). Initially in 1998, 29.9 percent of all counties, and 44 percent of rural nonadjacent counties, will be raised to the "floor" rate of $367 per member per month (Table 8). Over time, however, fewer counties would have their rate set at the floor because of the phase-in of the blending provisions. By 2003, only 12.9 percent of counties (but 23.3 percent of rural nonadjacent counties), will have their rates at the floor.

Figure 10.

Minimum Capitation Rate

Rates rise significantly in areas with lowest rates



Source: Rural Policy Research Institute (RUPRI) Health Panel

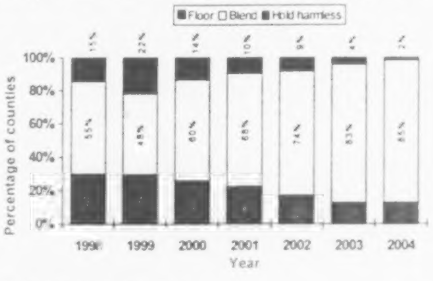
However, there are several reasons why the floor, and the dollar amount of the floor, is not as significant as it may seem at first glance. First, the percentage of counties that will have capitation rates set by the floor provision declines significantly over time. This can be seen in Figure 11, which shows that only 13 percent of counties will reside at the floor in 2004 (Figure 11). This is because of the transition to more aggressive blending (50/50) over time, which has the effect of lifting most counties above the floor. Second, the percentage of beneficiaries living in counties at the floor is even lower than the percentage of counties at the floor. For example, less than 3 percent of beneficiaries would reside in counties with a rate set by the floor in

2004. This occurs because counties at the floor tend to have much smaller populations than other counties.

Figure 11.

Which Provision is Most Important?

Percent of counties with rate determined by blend, floor or hold harmless provision



Source: Rural Policy Research Institute [illegible] Health Panel

The hold harmless" provision initially protects many counties from low growth in capitation rates as a result of other provisions, guaranteeing that a county's rate will not fall below 102 percent of the previous year's rate. Initially in 1998, 14.7 percent of counties, and 36.2 percent of central urban counties, will be guaranteed a growth rate of 2 percent as a result of this provision (Table 8). These counties would have experienced lower growth rates without the provision primarily as a result of the GME carveout provision and the phase-in of blended rates. Over time, however, the percentage of counties protected by the hold harmless provision falls to 1.9 percent of all counties and 8.6 of central urban counties by the year 2004. This occurs primarily because by 2004 the effects of blending and the GME carveout are fully phased in and Medicare per capita spending is growing faster. As shown, however, a significant proportion of counties will also have their rates set by the "hold harmless" provision in 1998 and 1999 (because of slower Medicare growth in these years). But over time the hold harmless provision also becomes less important with many of these counties having their rates set by the blending provisions.

The GME carve out. The final legislation subtracts ("carves out") from the local area-specific rate an amount representative of the amount of spending in the county that would go towards the Graduate Medical Education (GME) program. The provision to "carve out" GME funding could further the equity goals of policy reform since it leads to a significant lessening of the variation in rates across counties. In addition, this provision could improve health care delivery if the funds are sent to providers that use the funding. However, the ultimate effects of this provision on rural health delivery depend on the distribution of the carveout funds, totaling roughly $14.8 billion over the 1998-2004 period. If funds are not distributed to underserved areas, and a disproportionate amount of the funds are directed to central urban areas, then this provision will have less of an impact on equity and on meeting the needs of rural and underserved persons.

Caution in viewing the results of the GME carveout is also warranted because the carveout might help lead to a triggering of the budget neutrality provisions. An example might better illustrate this issue. Consider a hypothetical county with a 1997 AAPCC rate of $700 where 10 percent of payments made to recipients are destined for the GME program. Suppose this county's area-specific rate would increase by 4 percent to $728 in 1998 after applying the growth rate in national average payments. To compute the new capitation rates in 1998 under the new legislation, for example, this area-specific rate would be reduced by roughly 2 percent (20 percent of the GME payments), reducing it to roughly $713. When this area-specific rate is blended with the lower price-adjusted national rate (assume equal to $500), the blended rate would be $692, below the hold harmless rate of $714 (102 percent of the 1997 AAPCC rate). Thus, this hypothetical county would receive a capitation rate of $714 in 1998.

There are two important issues raised by examples like this. First, even though the legislation is designed to carve out GME payments, the full effects of the carve out are not achieved because only a portion of these payments are carved out in some counties.

Second, this provision has important implications for the budget neutrality of these proposals. The amount of dollars carved out and transferred for use in the GME program is equal to the amount carved out of the area-specific capitation rate ($728*.02=$14.56). However, since this amount is greater than the amount typically carved out of a county's rate, this provision ends up negatively affecting the budget neutrality of the proposal. For example, in the example cited above, the blended rate would also have been $714 without the GME carve out (because of the hold harmless provision). Thus the GME carveout does not lead to any decline in rates, yet about $15 per member, per month, enrolled in managed care is transferred to GME funds.

It is important to realize that if this provision triggers the budget neutrality adjustment (BNA), then the net effect of this will be to reduce blended rates in those counties with their rates set by the blended rates (the majority of counties). In effect, the increased expenditures triggered by the GME payments are subsidized by lower payments to counties receiving blended capitation rates. For example, if this provision leads to expenditures that exceed expenditures that would have been made otherwise by 2 percent, then blended rates (and not the floor and hold harmless rates) will be reduced across the board by 2 percent.

Despite this discussion, the budget neutrality problems created by the GME carve out are not large, primarily because GME funds are carved out over a five-year period.

VII. IMPLICATIONS

This paper presents detailed findings about the effects of the Balanced Budget Act on Medicare capitation rates in the 1997-2004 period. However, the ultimate impact of these policy changes is not clear from these results. In particular, there are important questions about the impact of these proposed changes on the rural health system. In particular:

- **If capitation rates are increased, will enrollment increase?** In other words, if the capitation rates are increased in rural areas and other areas with low AAPCC rates, will this increase in rates lead to more penetration of managed care plans? And will it encourage more recipients to enroll in managed care plans?

  In the counties with the lowest AAPCC rates in 1997, the increases in capitation rates will be significant, but it is not clear whether this will be enough to spur significant growth in managed care. Further research on this question will provide some evidence. However, if enrollment is not significantly spurred by this legislation, then the importance of the legislation is significantly reduced.

- **How much of increase will actually flow to rural counties?** In particular, payments to Medicare risk plans go directly to managed care organizations (MCOs). It is not clear how much of these funds will flow back to the counties where the recipients live. MCOs will keep some of the funds for administrative costs and profits. In addition, if the MCO is an urban-based plan, then those administrative costs will remain in the urban area even if the recipient lives in a rural area.

- **How much of increase will flow to rural providers?** Since some of the capitation rate will be kept by MCOs to cover their costs, this will reduce the funds that might flow to rural providers. In addition, it is well known that MCOs achieve their cost savings primarily through reduced hospitalizations and by making contracts with providers for discounted or reduced reimbursement rates. All this might lead to the conclusion that rural providers (especially hospitals and physicians) may actually see a drop in revenue after capitation rates are increased, especially if it spurs some recipients to switch from Medicare FFS to an MCO plan. It is difficult to predict the outcome, and it will differ by county. Also, some providers -- such as primary care providers -- will likely be impacted positively by increased managed care enrollment, while other rural providers -- especially specialist physicians and hospitals -- may be impacted negatively.

- **Ultimately, the goal of Medicare reform policy should be improving the delivery of health care to recipients, if possible within budgetary constraints.** If legislation to increase capitation rates spurs increases in enrollment in MCOs, the ultimate impact on the health care received by recipients will depend of course on the quality of care provided by the MCO. There is considerable controversy about the impact of MCOs on the quality of care. However, early evidence suggested that managed care did not significantly reduce the quality of care and may have increased it. However, more recent evidence focusing more directly on populations at risk (e.g., the elderly, seriously ill, disabled) suggests that the health care received by these population groups may be adversely affected by enrollment in managed care plans. Measuring this effect is very difficult, however, and much further research is being conducted on that.

To assess the impacts of the new methods for computing Medicare capitation rates on the issues raised here, further research is needed and this research is being pursued now in further extension of this work.

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Table 1.
Monthly Adjusted Average Per Capita Cost (AAPCC) rates paid to Medicare risk plans, 1990-97

	1990	1991	1992	1993	1994	1995	1996	1997
All counties (N=3,113)								
Mean	$247	$251	$266	$302	$315	$333	$372	$395
Minimum	$126	$126	$139	$168	$171	$177	$207	$221
Maximum	$477	$481	$508	$599	$653	$679	$881	$767
Variation: Standard deviation/mean	17.7%	18.0%	17.8%	18.4%	18.5%	18.6%	18.9%	19.4%
Percentage change in mean	Na	1.8%	5.9%	13.4%	4.3%	5.6%	11.9%	6.1%
Largest decrease in AAPCC rate	Na	-42.7%	-29.9%	-22.1%	-21.3%	-25.6%	-12.1%	-40.2%
Largest increase in AAPCC rate	Na	46.9%	71.2%	84.7%	26.6%	40.1%	75.9%	37.0%
Urban counties (N=836)								
Mean	$277	$280	$296	$338	$356	$376	$414	$439
Ratio of mean to national average	1.12	1.11	1.11	1.12	1.13	1.13	1.11	1.11
Minimum	$149	$150	$161	$191	$210	$212	$231	$256
Maximum	$477	$481	$508	$599	$653	$679	$759	$767
Variation: Standard deviation/mean	17.4%	17.5%	17.3%	17.7%	17.9%	18.1%	18.1%	18.1%
Percentage change in mean	Na	1.3%	5.7%	14.2%	5.2%	5.6%	10.0%	6.1%
Largest decrease in AAPCC rate	Na	-8.9%	-15.8%	-1.7%	-10.5%	-5.1%	1.3%	-3.7%
Largest increase in AAPCC rate	Na	25.4%	18.5%	32.8%	26.6%	17.7%	25.6%	24.2%
Rural adjacent counties (N=1,001)								
Mean	$239	$244	$259	$294	$308	$326	$365	$390
Ratio of mean to national average	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.99
Minimum	$157	$157	$166	$187	$196	$205	$216	$231
Maximum	$392	$408	$444	$513	$487	$527	$674	$693
Variation: Standard deviation/mean	14.6%	15.0%	14.7%	15.3%	15.0%	15.1%	16.2%	16.9%
Percentage change in mean	Na	2.2%	6.4%	13.4%	4.5%	5.9%	12.0%	7.1%
Largest decrease in AAPCC rate	Na	-13.0%	-8.8%	-2.3%	-11.7%	-25.6%	-4.3%	-9.8%
Largest increase in AAPCC rate	Na	20.5%	27.6%	84.7%	20.7%	21.0%	33.9%	33.2%
Rural non adjacent counties (N=1,276)								
Mean	$234	$239	$252	$284	$294	$309	$351	$369
Ratio of mean to national average	0.95	0.95	0.95	0.94	0.93	0.93	0.94	0.94
Minimum	$126	$126	$139	$168	$171	$177	$207	$221
Maximum	$406	$418	$464	$485	$528	$540	$881	$647
Variation: Standard deviation/mean	16.1%	16.8%	16.8%	17.0%	16.6%	16.5%	18.3%	18.7%
Percentage change in mean	Na	1.8%	5.5%	12.8%	3.4%	5.4%	13.4%	5.2%
Largest decrease in AAPCC rate	Na	-42.7%	-29.9%	-22.1%	-21.3%	-16.7%	-12.1%	-40.2%
Largest increase in AAPCC rate	Na	46.9%	71.2%	50.4%	18.2%	40.1%	75.9%	37.0%

SOURCE: **Rural Policy Research Institute (RUPRI) Health Panel AAPCC file (see text).**

Table 2.
Volatility in Medicare AAPCC Rates, 1990-97

	Average annual percent change in nominal AAPCC rate	Average of absolute values of annual percent change in:		Medicare risk plan penetration rate	Number of counties
		Nominal AAPCC rate	Local volatility		
All counties	7.04%	7.61%	3.42%	10.94%	3,113
By location:					
Urban	6.92%	7.21%	2.59%	13.99%	836
Rural adjacent	7.38%	7.76%	3.30%	2.06%	1,001
Rural nonadjacent	6.85%	7.75%	4.05%	0.57%	1,276
By Number of Medicare eligibles in county, December 1996					
Less than 500	6.17%	9.32%	7.26%	0.39%	113
500-999	6.27%	7.64%	4.79%	0.78%	205
1,000-4,999	7.18%	7.70%	3.52%	0.86%	1,463
5,000-9,999	7.31%	7.64%	3.02%	1.84%	626
10,000-99,999	6.90%	7.17%	2.59%	8.27%	641
100,000 or more	6.57%	6.66%	2.10%	21.35%	65
By Risk Plan penetration rate, December 1996					
None	6.88%	8.02%	4.36%	0.00%	528
0-1%	7.18%	7.64%	3.34%	0.13%	1,936
1%-5%	6.87%	7.42%	3.25%	2.85%	260
5%-10%	6.91%	7.24%	2.60%	7.52%	143
10-20%	6.90%	7.21%	2.80%	14.07%	138
20% or more	6.12%	6.47%	2.43%	32.53%	108
By AAPCC rate in 1997:					
Less than $300	5.13%	6.43%	3.88%	0.63%	271
$300-$399	6.53%	7.19%	3.38%	3.51%	1,506
$400-$499	7.85%	8.18%	3.35%	9.13%	1,049
$500-$599	8.54%	8.84%	3.44%	18.27%	248
$600 or more	8.67%	8.75%	3.34%	20.88%	39

SOURCE: Rural Policy research Institute (RUPRI) Rural Health Panel AAPCC file (see text).

NOTE: 1. Local volatility = nominal AAPCC growth less average growth in CPI (3.42 percent) less growth in the inflation-adjusted U.S. per capita cost (USPCC, 3.5 percent).

Table 3.
Provisions for setting Medicare risk plan capitation rates: H.R. 2015

Provision	Description of provision
Blending in 2002	50% Area-specific 50% National (adjusted for price differences across counties) Phased in over a six-year period, 1998-2003
Floor	$367 in 1998 (adjusted for Medicare per capita spending growth thereafter)
Hold harmless	102% of previous year's rate
Graduate Medical Education (GME) Carve-out	Fully carved out over a five year period, 1998-2002
Growth rate used to project future rates	Growth in per capita fee-for-service Medicare spending less 0.8% in 1998 and 0.5% in 1999-2002, 0.0% thereafter

SOURCE: Rural Policy Research Institute (RUPRI) Health Panel.

Table 4.
Impact of Capitation Payment Reform on Medicare Capitation Rates

			Metro/Nonmetro			
		Total	Central Urban	Other Urban	Rural Adjacent	Rural Nonadjacent
AAPCC rate, 1997	Average	$467	$542	$435	$395	$374
	Minimum	$221	$349	$256	$231	$221
	Variation in percent (a)	21.4%	16.0%	15.7%	16.3%	17.1%
Capitation rate, 1998	Average	$484	$555	$451	$416	$402
	Minimum	$367	$370	$367	$367	$367
	Variation in percent (a)	19.4%	15.5%	13.9%	12.7%	11.7%
Capitation rate, 1999	Average	$494	$567	$462	$425	$412
	Minimum	$378	$385	$378	$378	$378
	Variation in percent (a)	19.2%	15.5%	13.5%	12.4%	11.4%
Capitation rate, 2000	Average	$510	$582	$479	$441	$427
	Minimum	$392	$408	$392	$392	$392
	Variation in percent (a)	18.3%	14.9%	12.6%	11.6%	10.6%
Capitation rate, 2001	Average	$529	$599	$499	$459	$446
	Minimum	$409	$434	$409	$409	$409
	Variation in percent (a)	17.2%	14.0%	11.5%	10.7%	9.7%
Capitation rate, 2002	Average	$551	$620	$523	$481	$468
	Minimum	$429	$465	$429	$429	$429
	Variation in percent (a)	16.0%	13.0%	10.3%	9.8%	8.9%
Capitation rate, 2003	Average	$585	$653	$560	$514	$499
	Minimum	$454	$502	$454	$454	$454
	Variation in percent (a)	14.6%	11.5%	9.2%	8.8%	8.1%
Capitation rate, 2004	Average	$619	$689	$594	$545	$530
	Minimum	$480	$534	$480	$480	$480
	Variation in percent (a)	14.0%	10.7%	9.0%	8.5%	7.9%
Average Annual Volatility in rates (b)						
	1998	2.5%	1.8%	1.9%	3.6%	5.7%
	1999	1.0%	1.2%	0.9%	0.8%	0.7%
	2000	1.3%	1.6%	1.1%	0.9%	0.9%
	2001	1.3%	1.7%	1.1%	0.9%	0.9%
	2002	1.3%	1.8%	1.1%	1.0%	0.9%
	2003	1.3%	1.5%	1.3%	1.1%	1.0%
	2004	0.3%	0.6%	0.1%	0.1%	0.1%

SOURCE: Rural Policy Research Institute (RUPRI) Rural Health Panel, August 1997

NOTES: (a) Variation is defined as the average difference between county rates and the national average rate (computed as the ratio fo the standard deviation to the mean); (b) volatility is the average of the absolute value of annual percentage changes in capitation rates, over and above change attributable to growth in national average per capita Medicare expenditures (RUPRI, 1997)

Table 5.
Projected Medicare capitation rates in illustrative counties

County	State	Metro/Nonmetro Status	Number of Medicare eligibles	Medicare penetration rate	Actual AAPCC rate, 1997	Projected capitation rates 1998	2000	2002	2004
Arthur	NE	RNA	84	2.0%	$221	$367	$392	$429	$480
Webster	NE	RNA	1,116	0.1%	$236	$367	$392	$429	$480
San Juan	CO	RNA	62	1.6%	$241	$367	$392	$429	$480
Billings	ND	RNA	90	0.0%	$257	$367	$392	$429	$480
Clay	GA	RNA	626	0.2%	$307	$367	$392	$429	$480
Walla Walla	WA	RA	8,638	13.5%	$325	$367	$392	$454	$530
Stevens	MN	RNA	1,912	0.1%	$340	$367	$392	$444	$512
Los Alamos	NM	OU	2,058	4.9%	$365	$389	$433	$497	$575
York	ME	RA	27,655	0.1%	$366	$386	$422	$478	$553
Mecklenberg	NC	CU	66,514	0.1%	$381	$399	$432	$484	$557
Polk	IA	OU	46,723	0.0%	$402	$416	$443	$489	$557
Marquette	MI	RNA	110,157	0.0%	$465	$476	$498	$539	$608
Jefferson	KY	OU	113,063	6.5%	$465	$477	$499	$541	$612
Montgomery	OH	OU	94,411	5.1%	$467	$475	$493	$533	$606
Dallas	TX	CU	201,343	9.9%	$514	$524	$546	$577	$650
San Diego	CA	CU	328,387	46.9%	$517	$532	$562	$615	$698
Jefferson	AL	OU	113,608	11.9%	$525	$536	$558	$580	$638
Worcester	MA	OU	113,740	31.1%	$527	$538	$559	$588	$672
Fulton	GA	CU	82,308	1.6%	$536	$547	$569	$592	$657
Lake	CA	RA	13,429	5.9%	$550	$561	$583	$614	$688
Cook	IL	CU	703,319	12.5%	$559	$570	$594	$617	$685
Assumption	LA	RA	3,100	11.5%	$563	$574	$597	$622	$647
Los Angeles	CA	CU	903,758	34.5%	$623	$635	$661	$693	$778
Philadelphia	PA	CU	257,428	24.8%	$704	$718	$747	$778	$809
New York	NY	CU	214,151	7.5%	$713	$727	$757	$787	$819
Dade	FL	CU	303,108	37.2%	$748	$763	$794	$826	$859

SOURCE: Rural Policy Research Institute (RUPRI) Rural Health Panel, August 1997

NOTE: Metro/Nonemtro status CU=Central Urban, OU=Other Urban, RA=Rural adjacent, RNA=Rural Non-adjacent

Table 6.
Impact of Capitation Payment Reform on
Average growth in Medicare capitation rates, 1997 to 2004

	Average growth rate, 1997 to 2004: Nominal dollars	Adjusted for inflation
Average growth rate, all counties	33.3%	12.1%
By Metro/Nonmetro		
Central Urban	24.4%	4.6%
Other Urban	31.0%	10.2%
Rural Adjacent	31.9%	10.9%
Rural Nonadjacent	36.8%	15.0%
By AAPCC Rate in 1997		
Less than $300	64.5%	38.2%
$300-$399	37.5%	15.7%
$400-$499	24.1%	4.3%
$500 or more	15.4%	-3.0%
By Risk Plan Penetration Rate, 1996		
None	35.7%	14.1%
Less than 1%	34.2%	12.8%
1%-4.99%	31.1%	10.2%
5%-9.99%	26.9%	6.7%
10% or more	27.0%	6.8%

SOURCE: Rural Policy Research Institute (RUPRI) Rural Health Panel, August 1997

Table 7.
Distribution of U.S. counties
by projected capitation rate as a percentage of national average capitation rate, 1997-2004

Local capitation rate as a percent of national rate	Percent of counties							
	Actual 1997	1998	1999	2000	2001	2002	2003	2004
Less than 70%	18.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
70%-79%	24.9%	42.5%	41.2%	36.6%	32.1%	26.0%	20.5%	19.0%
80%-89%	23.8%	26.5%	28.0%	32.3%	35.6%	40.2%	44.1%	43.9%
90%-99%	17.4%	16.8%	16.5%	17.7%	19.5%	21.6%	24.2%	25.5%
100%-109%	8.2%	8.0%	8.0%	7.8%	7.7%	8.1%	7.7%	8.5%
110%-119%	4.6%	3.8%	3.7%	3.4%	3.2%	2.6%	2.3%	2.3%
120%-129%	2.9%	2.5%	2.5%	2.2%	1.9%	1.4%	1.2%	0.8%
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

SOURCE: Rural Policy Research Institute (RUPRI) Rural Health Panel, August 1997.

Table 8.
Impact of Capitation Payment Reform on
Percent of counties with rates determined by the "floor," "hold harmless," or "blending" provisions

		Metro/Nonmetro			
	Total	Central Urban	Other Urban	Rural Adjacent	Rural Nonadjacent
Percent of counties at the "floor"					
1998	29.9%	0.0%	12.7%	28.5%	44.0%
1999	29.5%	0.0%	11.4%	28.4%	43.7%
2000	26.2%	0.0%	7.6%	25.5%	39.9%
2001	22.6%	0.0%	5.0%	20.9%	36.1%
2002	17.2%	0.0%	2.1%	15.2%	28.9%
2003	12.9%	0.0%	1.2%	9.7%	23.3%
2004	12.9%	0.0%	1.2%	9.7%	23.3%
Percent of counties at "hold harmless" rate:					
1998	14.7%	36.2%	15.3%	14.4%	11.8%
1999	22.3%	48.3%	24.4%	22.2%	17.7%
2000	13.6%	34.5%	13.5%	13.6%	10.7%
2001	9.8%	27.0%	9.4%	9.7%	7.8%
2002	8.6%	23.0%	6.8%	8.4%	7.8%
2003	4.3%	13.2%	4.1%	4.2%	3.4%
2004	1.9%	8.6%	1.8%	2.0%	0.9%
Percent of counties receiving "blended rate"					
1998	55.4%	63.8%	72.0%	57.1%	44.2%
1999	48.2%	51.7%	64.2%	49.4%	38.6%
2000	60.2%	65.5%	78.9%	60.9%	49.4%
2001	67.6%	73.0%	85.6%	69.4%	56.1%
2002	74.2%	77.0%	91.1%	76.4%	63.3%
2003	82.8%	86.8%	94.7%	86.1%	73.3%
2004	85.2%	91.4%	97.0%	88.3%	75.8%

SOURCE: Rural Policy Research Institute (RUPRI) Rural Health Panel, August 1997.

THE COMMUNITY POLICY ANALYSIS SYSTEM (COMPAS) A PROPOSED NATIONAL NETWORK OF ECONOMETRIC COMMUNITY IMPACT MODELS

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Devolution of authority and responsibility from the Federal Government to state and local governments is, and will continue to be, one of the most dominant public policy issue for communities for the next decade. Block grants, deregulation, welfare reform, health care reform, education reform, agricultural policy reform, various state waivers, and other terms fill the national policy dialogue and all are symptomatic of devolution.

To communities, especially rural communities, devolution spells the end of many of the safety nets that protected local governments, school districts and other public entities from some economic and social hardships. At the same time devolution enhances opportunities for local leadership and increases the returns to aggressive and innovative public decision making. In this environment, the value of economic and social information, accurate projections and analyses of policy alternatives is particularly great. This in turn is creating an opportunity for those involved in the decision support sciences.

The Community Policy Analysis System (COMPAS) initiative is a response to this opportunity. It addresses the information needs of policy makers at the Federal, state and local levels. At the Federal level, there is a growing need for a better understanding of the local consequences of federal policy, especially policy that devolves responsibility to local governments. Similarly, state governments require information on the consequences of their policies on local governments as both state and local responsibilities change.

The need, under these emerging circumstances, for better decision support at the local level is obvious. The diversity of conditions in rural communities means that generic, or aggregated decision support tools probably conceal more than they reveal. Broad generalizations about policy impacts are usually uninformative at best, misleading at worst. It is clear, for example, that to conclude that trade liberalization will lead to overall increases in income and employment is an important aggregate projection but it tells us little about the changes that will be experienced by individual communities or what their optimum responses to these changes might be.

In response to these policy trends, a group of regional economists and rural social scientists have identified a set of modeling tools which can be used to provide policy decision support for state and local government officials, including input-output modeling, cost/benefit analysis, and industrial targeting. In addition, the group has developed a plan to build a collaborative community policy analysis network that will eventually extend to selected rural communities in twenty-five states. With initial support from the Rural Policy Research Institute (RUPRI), the four regional rural development centers and a variety of other sources, the group has also outlined the structure of econometric community models for each state that will compare the economic, demographic, and fiscal impacts of a variety of economic or policy scenarios. The models are intended to be used in conjunction with other decision tools to provide maximal flexibility and a capacity for rapid response to queries by local and state policy decision makers. This paper will focus on the specification and development of the COMPAS econometric community models. It will describe the conceptual framework of the proposed models, report on applications of the models in two states, and briefly discuss plans for future development and support of the COMPAS network. The plan takes into account the realities of secondary data availability at the community level and it attempts to build on current conceptual foundations from the social sciences and regional science. It is evolutionary in that it will be designed to be flexible and continually improved upon; and it addresses the institutional and constitutional differences among states and communities.

The COMPAS model discussed below is based primarily on the authors' experiences with the Virginia Impact Project (VIP) model, and Missouri's Show Me Community Impact Model which have evolved over the last decade. However, these models, are themselves just a recent chapter in a long tradition of community modeling by rural development researchers (see Halstead, Leistritz, and Johnson for a history of just some of these models). The novel aspect of this project is the attempt to create models for communities throughout the nation.

KEY PRINCIPLES

There are many considerations involved in modeling a community for policy analysis. The following assumptions are based on conceptual logic and/or empirical studies of communities. Each are reflected in the proposed COMPAS framework.

1. While economic and social relationships know no geopolitical boundaries, policy provisions, public services, taxing authority, and data, do. Therefore, county, municipal, and public service boundaries should be at the basis of any policy model.

2. Communities within states share common constitutional limitations and responsibilities, and have developed comparable institutions.

3. Communities with similar economic bases have similar economic structures. Because of the importance of climatic, geographic, social and political influences, economic bases are frequently quite homogeneous across geographic regions.

4. Communities of similar size and with similar geographic relationships to nearby larger and smaller communities, perform similar central place roles and are likely to exhibit similar responses to economic (and policy) stimuli.

5. The fundamental engine for economic growth, decline, and change at the local level is employment. Community impacts are effected through the labor market which allocates jobs between the currently unemployed, residents of nearby communities (incommuters), current residents who work outside the community (outcommuters), and new entrants to the local labor market.

6. Changes in employment, unemployment, commuting, labor force, population, school enrollment and income, lead to changes in housing needs, property tax base, public service demands, and transfers to households and local governments.

These principles guided the estimation and development of the Virginia Impact Projection (VIP) model and the Show Me Model for Missouri communities. Both models are systems of econometrically estimated equations for rural towns, counties and cities in the respective states, using both cross-sectional and time series data. Experience with the estimation of these models indicates that with careful selection of variables and functional form, stable coefficients can be estimated for communities with a wide variety of sizes and economic bases. Basic institutional differences cannot be captured with a single set of parameter estimates, however. Furthermore, attempts to apply the model to other states have underscored the importance of differences in the structure of public service provision. Therefore, only states with very similar local government structures will be candidate for grouping together.

MODEL STRUCTURE

While many different model structures could generate comparable policy analyses, the COMPAS models will share a basic structure. The COMPAS models will based on the assumptions above as well as others about the way in which rural and small city economies work, about the way in which local governments make decisions, and about the conditions under which local public services are provided. In the following pages, the first and most simple of the COMPAS models will be described.

Labor Market Equations

The labor market concept plays a central role in the COMPAS models. The models are built on the assumption that economic growth is caused largely by exogenous increases in employment. This is not to say that employment at the community level is not responsive to local conditions but rather, that these responses will be dealt with as direct changes or shocks to be introduced to the models. In this simple model, demand can be viewed as perfectly inelastic at the exogenous level of employment. Total labor supply is perfectly elastic at the prevailing regional or national wage level (adjusted for local cost of living, amenities, etc.). Labor supply is composed of two components: locally employed residents and locally employed non-residents or incommuters. Locally employed residents equals the resident labor force less unemployed outcommuters. These relationships are described below in Figure 1.

Figure 1: The Conceptual Labor Market

In- and out-commuters are separated here, rather than combined into net commuters, because they exhibit different in preferences for public services, spatial amenities, occupational characteristics of households, and because sub-markets for different labor skills persist. Labor force and incommuters are positive components of supply and outcommuting is a negative component. Unemployment is a residual negative component of supply. Eliminating wages from the component supply curves by substituting the inverse demand curve, as amended, derives the expressions. This introduces employment (demand) to the supply components. More formally, the model is developed as follows:

(1) $X_D = X_S$,

equates demand and supply (local employment and employed labor force from all locations). The demand curve is

(2) $X_D = f(w)$,
(where w is the wage rate) which when inverted becomes

(3) $w = g(X_D)$.

Decomposing labor supply into its components gives

(4) $X_S = X_{LF} - X_U - X_O + X_I$.

Each component of supply is a function of employment and a vector of supply shifters,

(5) $X_{LF} = f_L(w,Z_{LF}) = f_L(g(X_D),Z_{LF})$,

(6) $X_O = f_O(w,Z_O) = f_O(g(X_D),Z_O)$, and

(7) $X_I = f_I(w,Z_I) = f_I(g(X_D),Z_I)$,

where, X_D is labor demand (local employment), X_S is labor supply, made up of its components, X_{LF} (resident labor force), X_O (outcommuters), X_I (incommuters), and X_U (unemployed), w is the wage rate, and the Zs are supply shifters for the various components of supply. Given the discussion and the conceptual model above, equations 4 through 7 can be expressed as follows in equations 8 through 11.[1]

(8) Unemployed = Labor Force + Incommuters - Employment - Outcommuters

All three components of labor supply will be primarily determined by employment in the location in question. In addition, they will depend on relative housing conditions, costs of living, quality of public services, tax levels, the mix of jobs, and similar variables in the location of employment, versus alternative locations. A very important variable in the supply components is area of the data unit. Smaller units will include fewer resident laborers, and define more as outcommunters and incommuters because the cross the borders of the unit. Larger units will incorporate more destinations and residences of workers and, therefore, define more workers as being locally employed, and thus fewer outcommuters and incommuters. In addition, commuting will depend on the distance between place of residence and place of work.

(9) Labor force = f(employment, housing conditions, cost of living, public services, taxes, industry mix, area).

(10) Outcommuting = f(employment, external

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employment, external labor force, housing conditions, cost of living, public services, taxes, industry mix, area, distance to jobs).

(11) Incommuting = f(employment, external employment, external labor force, housing conditions, cost of living, public services, taxes, industry mix, area, distance to residence).

Population is hypothesized to be a function of labor force and variables that affect the labor force participation rate and the dependency ratio.

(12) Population = f(labor force, participation rate, dependency rate),

Where the dependency rate is the ratio of the non-working population to the working population.

Fiscal Impact Equations

Changes in the tax base and changes in the need for expenditures usually accompany changes in employment. New employers, employees and population require expenditures for services and investments in infrastructure. The demands for public services by residents depend on such factors as income, wealth, unemployment, age, and education. As growth changes these characteristics, the demand per resident will rise or fall. Furthermore, as a community grows the average cost of producing public services often decreases, until all economies of size are captured, and then increases, when inefficiencies creep in to the process. Together, the changing demand and efficiency determinants mean that each economic change will have a unique effect on needed expenditures.

It is assumed that local governments consider the demands of their constituents, and provide the desired level of services at the lowest possible cost. When tax bases and the demand for expenditures are known, local governments are assumed to adjust tax rate to balance their budget.

Following Hirsch (1970 and 1977); Beaton; Stinson; and Stinson and Lubov; unit cost of public services are hypothesized to be a function of the level, and quality of services, important local characteristics (input factors and demand factors), input prices, and the rate of population growth. Furthermore, theory suggests that public services may be subject to increasing, and/or decreasing returns to size. Based on these theoretical relationships local government service expenditures per capita are hypothesized to be determined as follows:

(13) Expenditures = f(quality, quantity, input conditions, demand conditions).

For each type of expenditures (public works, police protection, administration, parks and recreation, welfare, education, fire protection, etc.) the independent variables are defined differently. For education enrollment is the quantity variable, teachers per thousand students is a quality variable, federal aid and change in enrollment are input conditions, and income, real property, and employment are demand conditions. For police protection, population is the quantity variable, solved crimes is the quality variable, percent population in towns, incommuters, and miles to the nearest metropolitan area are input conditions, and income and personal property are demand conditions.

Many non-local revenues (from state and federal agencies) are at least partially formula driven. Even when this is not the case, certain local characteristics may indicate the expected level of these revenues. In addition, non-local revenues are frequently an inverse function of the locality's ability to pay and a direct function of its degree of political influence. Ability to pay is usually related to per capita income, personal property per capita, and real property per capita.

(14) Non-local aid = f(expenditures, income, personal property, real property).

Another important source of local revenues is sales tax revenues. The level of retail sales is primarily a function of income. This relationship is expected to change with the size of the locality since larger localities are usually higher order service centers. The number of incommuters is also hypothesized to influence sales because they increase the daytime population of the community. Sales tax revenues are hypothesized, therefore, to be:

(15) Sales tax Revenues = f(income, employment, incommuters).

Other local revenues, other than property taxes, include licenses, fees, fines, forfeitures, and special assessments. These revenues are hypothesized to be related to the level of commercial activity (retail activity) in the community and the income level. Thus:

(16) Other Tax Revenues = f(Sales tax revenues, income).

Real property includes both residential and business property and, therefore, will be influenced by the level of personal income as well as the size of the economic base. Both personal and real property are hypothesized to be positively related to the number of outcommuters since these families represent a source of wealth that is not supported by the local economic base.

(17) Real Property = f(income, employment, outcommuters),

(18) Personal Property = f(income, outcommuters).

There are a number of ways to close this type of mode. In the case of the VIP model it is assumed that local government expenditures are determined first, and real and personal property tax rates are set to cover those expenditures not met by non-local aid and sales tax revenues and other tax revenues. This implicitly assumes that budgets are balanced each year. An alternate assumption (the one used in the Show Me) is that the tax rate remains constant and that economic changes lead to fiscal deficits or surpluses.

THE MODELS APPLIED

To date, the VIP and Show Me models have been developed for forty to fifty communities. Similar models have been developed and applied in the several communities in Iowa (Swenson, 1996), Idaho (Fox and Cooke, 1996) and Wisconsin (Deller and Shields, 1996). Local advisory committees are usually appointed to review the baseline projections, help form the scenarios, review the model's projection, and to help interpret the results. The models have been used for a variety of purposes including analyses of annexations, jurisdictional mergers, new industries, existing industries, industry closures, university research parks, shopping centers, residential developments, location of industrial sites and, and general development strategies. They have also been used for goal planning for several communities. Goal planning with the models is achieved by estimating the conditions necessary to bring about a desired set of terminal conditions.

The models have generally been popular with local and state governments. Policy makers are generally somewhat skeptical until they come to appreciate the information generated and become more confident in the projections. Repeat users of the model's projections especially like the comparability of the results from case to case, and across communities.

DISCUSSION

The devolution of policy decisions from central to local control will bring communities many new opportunities and many significant new challenges. Especially those that are small or otherwise disadvantaged may now need the capacity to assess the future impacts of a variety of expected or proposed changes. The Community Policy Analysis System is one approach for rural development researchers to assist in developing that capacity.

COMPAS models now exist in at least five states. Preliminary plans are now in place to extend that to seven, fifteen, and ultimately twenty-five states over the next three years. In the next six months, researchers involved in this initiative will review, refine and test the conceptual framework of the COMPAS models and specify data and research standards that will make results from these models comparable and compatible. If resources are available, these researchers will form a network designed to provide analysis of the community impacts of local, state and federal policy alternatives.

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[1] If ones estimate of employment is defined as jobs, rather than the number of persons employed, then it will include second jobs. In this case, employment as defined here equals jobs less second jobs. Alternatively, one must augment the supply of labor by the number of individuals holding second and third jobs.

PROJECTIONS OF REGIONAL ECONOMIC AND DEMOGRAPHIC IMPACTS OF FEDERAL POLICIES

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Improved information on the regional impacts of federal policies would address an important need of decision makers, including citizens who make their political choices seriously. Regional variations in the demographic and economic environment lead to regional variations in the impacts of federal policies. For example, the percentage of the population that is elderly and that is poor varies by region; many programs use age and income as factors in determining eligibility and payments. Looking at another important example, regional economies vary in the importance of new investment and of international competition; the change in the real interest rate due to changes in the federal budget deficit will have different impacts in different regions. Little is known about these regional variations because few analysts are studying them.

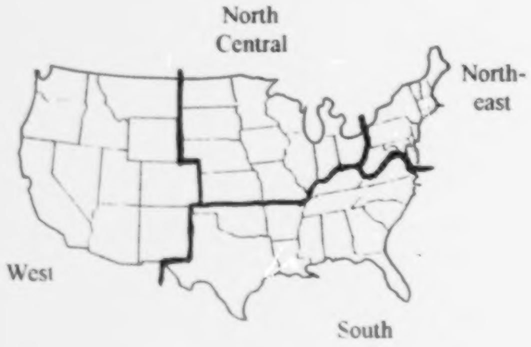
The objective of the work described in this paper is to provide estimates of the regional demographic and economic impacts of current and proposed federal policies. The primary audience consists of decision makers and their staffs at the federal level. An important secondary audience consists of state and local decision makers and of citizens who seek information on federal policies in order to influence policy in an informed manner. Another important audience consists of researchers who seek better methods of sub-national analyses and improved data.

The remainder of this paper will address the research design for this project, the explicit inclusion of the federal budget deficit, model solution procedures, Medicare and Medicaid data, a preliminary baseline solution, and analyses of alternative policies.

Research Design

This research produces information on sub-national regions as traditionally defined and on county groupings representing the rural-urban continuum. The four sub-national regions used in the analysis are shown in Figure 1. They follow the boundaries of four Rural Development Centers who are clientele for this work. A larger number of smaller sub-national regions would be desirable, but the use of only four regions is not a major problem at this stage of the research.

Figure 1. RUPRI Sub-National Regions



The counties within each sub-national region are partitioned into four categories representing the rural-urban continuum. Nonmetropolitan counties not adjacent to a metropolitan area make up the most rural category. Nonmetropolitan counties adjacent to a metropolitan area make up a rural category which is less remote from a large urban concentration than other nonmetropolitan counties. The central cities of the 32 largest metropolitan areas are represented by 62 densely populated counties and are the most urban category. The remaining metropolitan counties make up a less densely settled urban category.

These categories are proving to be workable, but they have significant problems. I would prefer a definition that treats rural and urban as partitions on a symmetrical continuum rather than the current out-dated, urban-centered definition of metropolitan and nonmetropolitan. I am currently exploring the suggestion of John Adams to use relative density within the nation and state, to which I would add a third factor of relative density within a sub-national region such as those in Figure 1.

Several large counties of mixed rural-urban character lessen the distinctions between the categories. For purposes of analyses, we should partition six large counties in southern California and the four large counties containing Duluth, Phoenix, Reno, and Tucson into their rural and urban parts. We could then treat each part in exactly the same way as we treat other counties in the analysis.

The combination of four sub-national regions and four categories on the rural-urban spectrum yields sixteen county groupings. These are the geographic units of analysis. The counties within each grouping do not form a contiguous set which makes this framework different from most other regional studies. Table 1 presents a few descriptive statistics on the county groupings.

Table 1. Selected Descriptive Statistics on the RUPRI County Groupings, percent of U.S.

Population (1994)

	N.E.	South	N.C.	West	Total
Nonmetro	2.7	8.3	6.3	3.2	20.5
Not Adjacent	0.9	3.4	2.9	1.9	9.1
Adjacent	1.7	5.0	3.3	1.4	11.4
Metro	20.2	23.4	17.3	18.6	79.5
Not Cen City	13.5	17.6	10.6	10.0	51.6
Central City	6.7	5.8	6.7	8.6	27.9
Total	22.9	31.7	23.6	21.8	100.0

Area (square miles)

	N.E.	South	N.C.	West	Total
Nonmetro	3.3	17.5	17.5	42.5	80.9
Not Adjacent	1.5	8.6	11.8	35.3	57.3
Adjacent	1.8	8.9	5.7	7.2	23.6
Metro	2.3	6.1	3.7	7.0	19.1
Not Cen City	2.2	5.8	3.5	6.4	18.0
Central City	0.1	0.3	0.2	0.6	1.2
Total	5.6	23.6	21.2	49.5	100.0

Counties and County Equivalents

	N.E.	South	N.C.	West	Total
Nonmetro	4.7	30.5	26.6	11.9	73.8
Not Adjacent	2.0	14.5	16.7	8.9	42.1
Adjacent	2.7	16.0	9.9	3.1	31.7
Metro	4.9	11.4	7.1	2.9	26.2
Not Cen City	4.3	10.8	6.6	2.6	24.2
Central City	0.6	0.6	0.5	0.3	2.0
Total	9.6	41.9	33.7	14.9	100.0

This work emphasizes insights on the spatial impacts of federal policies. The Rural Policy Research Institute (RUPRI) utilizes the work of other credible sources on national impacts in order to conserve scarce resources and to avoid conflicts peripheral to RUPRI's primary mission. We use the demographic projections of the U.S. Bureau of the Census and the economic and budget projections of the Congressional Budget Office (CBO) for assumed national totals (Day; Congressional Budget Office).

RUPRI purchases the service of building and maintaining the sixteen models for the county groupings from Regional Economic Models, Inc. (REMI). We adopted this approach because we prefer to have RUPRI staff focused on policy analysis and because an established outside vendor could deliver operational models with short notice and on time. The REMI modeling framework is described in Treyz and is widely recognized as one of the best systems for quantitative regional analyses. The models include integrated demographic and economic components. They are a hybrid of input-output, econometric and selected computable equilibrium characteristics. They estimate a series of annual solutions rather than utilize benchmarks. The sixteen models solve interactively with labor moving to county groupings with higher expected returns to labor and with capital flowing to county groupings with high expected returns to investment. The aggregate solution for the U.S. is the sum of the county groupings, that is, the solution is "bottom up" rather than "top down".

RUPRI has chosen to purchase REMI models employing the standard 14 industrial sectors at the single-digit SIC code level. We would prefer 53 sector models--the next step up in the REMI options--except that, with current resources, we prefer to constrain the funds devoted to model purchases in order to devote them to activities directly focused on policy analyses. The major advantage of the 53 sector option to us would be an explicit medical services industry. Because much of the health sector is subsumed within the government sector, however, the 53 sector option is not as big of improvement as casual observers might expect. With both the 14 and 53 sector models the analyst must carefully specify, external to the model, the sectors being affected by health policy changes.

Incorporating the Federal Budget Deficit

Changes in federal policies typically include two complementary facets. The degree to which both are visible varies from case to case. One facet is the change in a specific program of interest, such as Medicare or Medicaid. The other facet is the change in the federal fiscal situation and programmatic mix which accompanies the specific program at the center of the discussion. For example, a cut in projected Medicare expenditures is associated with a combination of a lower federal budget deficit, lower federal taxes, and increased spending on other federal programs.

Good policy analysis should take into account both facets. Ignoring one facet reduces the scientific rigor of the analysis and leads to erroneous estimates. In addition, citizens and decision makers differ in the relative importance they place on the facets. An analyst who ignores, for example, the positive effects of deficit reduction while focusing on the negative effects of cuts in projected Medicare spending is appropriately viewed as adopting a partisan stance. In RUPRI we seek a long term, constructive, non-partisan engagement with decision makers.

Many local and regional policy analyses have violated this principle. A lack of attention to the effects of changes in the federal budget deficit has been a particular, important problem in many cases.

One of the important strengths of the RUPRI analysis is that it accounts for changes in the federal budget deficit. This is especially important in policy analyses of proposals to lower projected federal budget deficits by cutting projected entitlement spending on the baby boom population when its members become eligible for programs targeted on the elderly.

The particular manner in which RUPRI incorporates the federal budget deficit is applicable to many other modeling situations. The REMI model does not have an explicit federal fiscal component. The effects of federal fiscal actions consistent with existing policies (the "baseline" solution) are incorporated as follows. (The table references in the remainder of this paragraph refer to Council of Economic Advisers. These tables illustrate the identity being discussed and provide historical data.) First, CBO estimates of national GDP and of the federal budget deficit are adopted as RUPRI assumptions. Second, we in RUPRI estimate national gross saving by major component for each year in the projection period. These components include the federal budget deficit, federal consumption of fixed capital, state and local government saving, personal saving, and gross business saving (Table B-30).

Third, we estimate the components of national gross investment: gross private domestic investment, gross government investment, net exports, and net foreign investment other than net exports (Tables B-22 and B-31). Fourth, having now estimated the investment and net export portions of GDP, we estimate how the remaining portion is divided between consumption and government, taking into account the previously estimated gross government investment (Tables B-1 and B-18). In conclusion, the estimates of consumption, investment, government, and net exports are the variables that reflect RUPRI assumptions with regard to the federal budget deficit--as well as numerous other matters.

The analysis of a proposed policy alternative proceeds analogously to the above procedure. The change in the federal budget deficit as well as the programmatic change a[illegible]oduced explicitly in the formulation of macroeconomic assumptions. In general, this explicit consideration of the change in the federal budget deficit leads to the conclusion that the policy change affects every component of GDP, and often total GDP as well.

Consistent National and Sub-National Solutions

The sixteen models for the county groupings must be solved in a manner that preserves the rigor of the structure within the models driving the solution (that is, the rigor of a "bottom up" approach) and that also incorporates the assumptions with respect to national GDP by major component. This is accomplished by solving the system of sixteen models iteratively, making changes in selected assumptions in the models in each iteration, until the summations from the sixteen models match the assumed national totals.

In slightly more detail, the solution procedure flows as follows. First, assumptions are made in the models with respect to demographic variables such as birth rates, death rates, and immigration and with respect to economic variables such as labor force participation, productivity, exports, imports, and government spending that we believe will lead to national demographic and economic outcomes consistent with our assumptions. Second, we solve the models as an interactive system and compute sums over the sixteen models to derive national totals. Third, we compare the output of the models with our assumptions. If the output is consistent with our assumptions, we have a satisfactory solution which we proceed to analyze. If the output differs significantly from our assumptions with regard to national totals, we return to step one noted above.

Medicare and Medicaid Data

RUPRI scientists are analyzing Medicare and Medicaid policies because of their importance to the nation, their rapid growth since inception, and their rapid projected growth in the future--especially when the members of the post-war baby generation become eligible. The analysis of policy alternatives has been slowed by the poor quality of the data.

RUPRI has contributed significantly to a marked improvement in readily accessible county-level Medicare data. When RUPRI regional scientists began work on Medicare in 1994, they found that the county-level data from the Consolidated Federal Funds Report, originally estimated by the Health Care Financing Administration (HCFA) and disseminated by the U.S. Bureau of the Census, were poorly documented and inaccurate. These Medicare estimates were also used by the Bureau of Economic Analysis (BEA) in estimating "medical transfer payments" in the Regional Economic Information System (REIS). Working with the Office of the Actuary in HCFA, RUPRI developed a superior county-level data base and disseminated it in 1995 (Nelson and Braschler). BEA began utilizing these higher quality Medicare data in REIS with the release of its county-level CD-ROM in September 1997 (Bureau of Economic Analysis). This recent release also marks the first occasion in which BEA is disseminating an explicit Medicare series, in contrast to the previous practice of issuing an aggregate total containing Medicare and other medical transfers. The Census Bureau has not changed its sources and methods as of early September 1997.

The available county-level Medicaid data are needlessly inaccurate. As of September 1997 the best source of county-level Medicaid payments is the BEA CD-ROM (Bureau of Economic Analysis). BEA obtains these data through direct contacts with individual states. BEA has actual county-level data on 34 states of which 26 are up-to-date (Bureau of Economic Analysis, Table F). For those states not providing data, BEA estimates county payments using the distribution of AFDC payments, which is likely inaccurate because the majority of Medicaid payments go to the elderly population rather than the AFDC population.

HCFA manages the Medicaid Statistical Information System (MSIS) project which currently includes 34 states. The recent balanced-budget legislation contains a provision requiring all states to participate in the MSIS project, so this information source will be increasingly complete as time passes. The MSIS records include a county identifier and could be used to produce county-level data. HCFA has declined to produce these data in its responses to RUPRI requests.

The needed next step to improve our county Medicaid data base is for HCFA to compile county-level Medicaid payment data for those states in the MSIS project and to provide the data to BEA. BEA could then incorporate these data in its REIS CD-ROM which is distributed widely at low cost. If this were done, the BEA would lack actual county-level Medicaid for only seven states--and this gap would decline in the future as the MSIS project expands. So long as the gap in coverage exists, a better county estimation procedure should be developed for those states not supplying county data to either HCFA or BEA.

As is often the case, improvements in the information base underlying the analysis of policies have been an important component of good policy analysis.

Baseline Solution

Elements of the initial baseline solution from the current models and methods are displayed in Tables 2-6. (A baseline from an earlier, simpler model without explicit attention to the federal budget deficit was published in 1995; see Braschler, Nelson, and Van der Sluis.) This baseline was estimated using the CBO current policy projections as of January, 1997 (CBO). These initial projections are of interest primarily because they help us to understand and critique the models.

The insights of informed, concerned people must be solicited and then incorporated into the estimates before the baseline becomes an insightful tool for policy purposes. This has not yet occurred with this baseline. The baseline will change significantly in subsequent revisions in order to reflect the consensus of experts as well as to incorporate updated CBO projections. Readers should keep these points in mind as they review the results in Tables 2-6. I solicit and welcome feedback from readers who have comments on the results.

I will not attempt a summary of the projections in this paper. The following are three, related features that surprise me and warrant further attention. The relative competitive position of central cities is projected to improve markedly, especially in the Northeast and North Central regions. The projected changes in manufacturing jobs are often markedly different from recent trends. The ratios of variables such as jobs to population and income to gross product change in ways not consistent with recent trends.

We in RUPRI find it intellectually and practically satisfying that the critique of these projections must include experts on trends in urban areas, and especially in central cities, if we are to gain insights on likely trends in rural areas. Regional economic and demographic changes are typically the result of relative shifts in causal variables in multiple regions

Table 2. Projected Population Assuming Current Policies Continue, 1987-2005

Area	Population (thou.)			Population as a % of U.S.			Pop. Change (%)	
	1987	1996	2005	1987	1996	2005	1996/1987	2005/1996
United States	242,321	265,408	286,454	100.00	100.00	100.00	9.53	7.93
Rural-Urban County Groupings of the U.S.								
Nonmetro Not Adjacent to Metro	22,866	23,623	23,709	9.44	8.90	8.28	3.31	0.36
Nonmetro Adjacent to Metro	28,127	30,065	30,994	11.61	11.33	10.82	6.89	3.09
Metro Other Than Central City	121,939	138,134	152,331	50.32	52.05	53.18	13.28	10.28
Central City of Large Metro	69,389	73,586	79,420	28.64	27.73	27.73	6.05	7.93
Sub-National Regions of the U.S.								
Northeast	58,006	60,184	63,716	23.94	22.68	22.24	3.75	5.87
South	75,520	84,912	93,001	31.17	31.99	32.47	12.44	9.53
North Central	59,026	61,909	63,792	24.36	23.33	22.27	4.88	3.04
West	49,769	58,403	65,945	20.54	22.00	23.02	17.35	12.91
County Groupings by Rurality and Region								
Nonmetro Not Adjacent to Metro								
Northeast	2,336	2,358	2,332	0.96	0.89	0.81	0.94	-1.10
South	8,564	8,772	8,784	3.53	3.31	3.07	2.43	0.14
North Central	7,576	7,621	7,459	3.13	2.87	2.60	0.59	-2.13
West	4,390	4,872	5,134	1.81	1.84	1.79	10.98	5.38
Nonmetro Adjacent to Metro								
Northeast	4,343	4,620	4,890	1.79	1.74	1.71	6.38	5.84
South	12,298	13,006	13,276	5.08	4.90	4.63	5.76	2.08
North Central	8,412	8,727	8,655	3.47	3.29	3.02	3.74	-0.83
West	3,074	3,712	4,173	1.27	1.40	1.46	20.75	12.42
Metro Other Than Central City								
Northeast	33,493	35,626	38,178	13.82	13.42	13.33	6.37	7.16
South	40,659	47,427	53,272	16.78	17.87	18.60	16.65	12.32
North Central	25,830	28,113	29,497	10.66	10.59	10.30	8.84	4.92
West	21,956	26,968	31,385	9.06	10.16	10.96	22.83	16.38
Central City of Large Metro								
Northeast	17,834	17,580	18,317	7.36	6.62	6.39	-1.42	4.19
South	14,000	15,707	17,669	5.78	5.92	6.17	12.19	12.49
North Central	17,208	17,448	18,182	7.10	6.57	6.35	1.39	4.21
West	20,348	22,851	25,252	8.40	8.61	8.82	12.30	10.51

Table 3. Projected Gross Product Assuming Current Policies Continue, 1992 dollars, 1987-2005

	Gross Product (bil.)			Gross Product as a % of U.S.			Gr. Prod. Change (%)	
Area	1987	1996	2005	1987	1996	2005	1996/1987	2005/1996
United States	5,677.4	6,908.5	8,320.3	100.00	100.00	100.00	21.68	20.44
Rural-Urban County Groupings of the U.S.								
Nonmetro Not Adjacent to Metro	402.5	511.9	594.3	7.09	7.41	7.14	27.18	16.10
Nonmetro Adjacent to Metro	482.1	611.1	714.9	8.49	8.85	8.59	26.76	16.99
Metro Other Than Central City	2,698.5	3,405.8	4,117.3	47.53	49.30	49.48	26.21	20.89
Central City of Large Metro	2,094.2	2,379.6	2,893.8	36.89	34.44	34.78	13.63	21.61
Sub-National Regions of the U.S.								
Northeast	1,450.2	1,647.2	1,975.6	25.54	23.84	23.74	13.58	19.94
South	1,679.1	2,120.4	2,523.1	29.58	30.69	30.32	26.28	18.99
North Central	1,333.4	1,628.5	1,939.6	23.49	23.57	23.31	22.13	19.10
West	1,214.7	1,512.4	1,882.0	21.40	21.89	22.62	24.51	24.44
County Groupings by Rurality and Region								
Nonmetro Not Adjacent to Metro								
Northeast	40.3	48.9	57.9	0.71	0.71	0.70	21.34	18.40
South	146.3	181.8	209.1	2.58	2.63	2.51	24.27	15.02
North Central	130.9	167.3	194.0	2.31	2.42	2.33	27.81	15.96
West	85.0	113.9	133.3	1.50	1.65	1.60	34.00	17.03
Nonmetro Adjacent to Metro								
Northeast	78.1	94.2	114.2	1.38	1.36	1.37	20.61	21.23
South	208.7	259.8	296.0	3.68	3.76	3.56	24.48	13.93
North Central	139.7	182.9	215.0	2.46	2.65	2.58	30.92	17.55
West	55.6	74.2	89.7	0.98	1.07	1.08	33.45	20.89
Metro Other Than Central City								
Northeast	790.7	935.7	1,126.4	13.93	13.54	13.54	18.34	20.38
South	896.0	1,152.8	1,378.1	15.78	16.69	16.56	28.66	19.54
North Central	549.4	694.7	833.8	9.68	10.06	10.02	26.45	20.02
West	462.5	622.6	779.0	8.15	9.01	9.36	34.62	25.12
Central City of Large Metro								
Northeast	541.1	568.3	677.1	9.53	8.23	8.14	5.03	19.14
South	428.1	525.9	639.9	7.54	7.61	7.69	22.85	21.68
North Central	513.4	583.6	696.8	9.04	8.45	8.37	13.67	19.40
West	611.6	701.8	880.0	10.77	10.16	10.58	14.75	25.39

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Table 4. Projected Jobs Assuming Current Policies Continue, 1987-2005

Area	Jobs (thou.)			Jobs as a % of U.S.			Jobs Change (%)	
	1987	1996	2005	1987	1996	2005	1996/1987	2005/1996
United States	129,995	148,892	166,342	100.00	100.00	100.00	14.54	11.72
Rural-Urban County Groupings of the U.S.								
Nonmetro Not Adjacent to Metro	10,803	12,472	13,229	8.31	8.38	7.95	15.45	6.07
Nonmetro Adjacent to Metro	12,547	14,426	15,401	9.65	9.69	9.26	14.98	6.76
Metro Other Than Central City	63,617	75,382	84,874	48.94	50.63	51.02	18.49	12.59
Central City of Large Metro	43,028	46,612	52,838	33.10	31.31	31.76	8.33	13.36
Sub-National Regions of the U.S.								
Northeast	32,020	33,779	37,781	24.63	22.69	22.71	5.49	11.85
South	39,221	46,701	51,431	30.17	31.37	30.92	19.07	10.13
North Central	31,535	36,146	39,461	24.26	24.28	23.72	14.62	9.17
West	27,220	32,266	37,670	20.94	21.67	22.65	18.54	16.75
County Groupings by Rurality and Region								
Nonmetro Not Adjacent to Metro								
Northeast	1,064	1,187	1,291	0.82	0.80	0.78	11.56	8.76
South	3,807	4,285	4,439	2.93	2.88	2.67	12.56	3.59
North Central	3,794	4,313	4,520	2.92	2.90	2.72	13.68	4.80
West	2,138	2,687	2,979	1.64	1.80	1.79	25.68	10.87
Nonmetro Adjacent to Metro								
Northeast	2,000	2,210	2,480	1.54	1.48	1.49	10.50	12.22
South	5,305	6,019	6,246	4.08	4.04	3.75	13.46	3.77
North Central	3,846	4,437	4,680	2.96	2.98	2.81	15.37	5.48
West	1,396	1,760	1,995	1.07	1.18	1.20	26.07	13.35
Metro Other Than Central City								
Northeast	18,154	19,711	22,046	13.97	13.24	13.25	8.58	11.85
South	21,237	26,030	29,051	16.34	17.48	17.46	22.57	11.61
North Central	13,201	15,707	17,385	10.16	10.55	10.45	18.98	10.68
West	11,025	13,934	16,391	8.48	9.36	9.85	26.39	17.63
Central City of Large Metro								
Northeast	10,802	10,671	11,963	8.31	7.17	7.19	-1.21	12.11
South	8,872	10,368	11,695	6.82	6.96	7.03	16.86	12.80
North Central	10,694	11,688	12,875	8.23	7.85	7.74	9.29	10.16
West	12,660	13,886	16,305	9.74	9.33	9.80	9.68	17.42

Table 5. Projected Total Personal Income Assuming Current Policies Continue, 1992 dollars, 1987-2005

Area	Total Personal Income (bil.)			Personal Income as a % of U.S.			Income Change (%)	
	1987	1996	2005	1987	1996	2005	1996/1987	2005/1996
United States	4,700.1	5,711.4	6,764.7	100.00	100.00	100.00	21.52	18.44
Rural-Urban County Groupings of the U.S.								
Nonmetro Not Adjacent to Metro	329.7	395.6	441.7	7.01	6.93	6.53	19.98	11.66
Nonmetro Adjacent to Metro	423.0	510.3	579.9	9.00	8.93	8.57	20.64	13.64
Metro Other Than Central City	2,394.4	2,988.4	3,576.2	50.94	52.32	52.87	24.81	19.67
Central City of Large Metro	1,553.1	1,817.1	2,166.9	33.04	31.82	32.03	17.00	19.25
Sub-National Regions of the U.S.								
Northeast	1,286.7	1,496.6	1,754.7	27.38	26.20	25.94	16.31	17.25
South	1,289.6	1,639.2	1,931.2	27.44	28.70	28.55	27.11	17.81
North Central	1,111.9	1,323.1	1,517.3	23.66	23.17	22.43	19.00	14.68
West	1,011.9	1,252.5	1,561.4	21.53	21.93	23.08	23.78	24.66
County Groupings by Rurality and Region								
Nonmetro Not Adjacent to Metro								
Northeast	35.1	41.0	46.6	0.75	0.72	0.69	16.80	13.75
South	112.3	134.7	148.4	2.39	2.36	2.19	20.01	10.15
North Central	116.2	134.3	145.7	2.47	2.35	2.15	15.52	8.54
West	66.1	85.6	100.9	1.41	1.50	1.49	29.48	17.91
Nonmetro Adjacent to Metro								
Northeast	74.0	86.3	100.9	1.58	1.51	1.49	16.57	16.92
South	168.9	207.3	231.3	3.59	3.63	3.42	22.73	11.58
North Central	131.7	153.7	170.9	2.80	2.69	2.53	16.70	11.17
West	48.2	62.9	76.7	1.03	1.10	1.13	30.35	21.99
Metro Other Than Central City								
Northeast	756.7	888.0	1,046.2	16.10	15.55	15.47	17.35	17.81
South	715.1	931.5	1,112.6	15.21	16.31	16.45	30.27	19.44
North Central	488.0	598.7	698.0	10.38	10.48	10.32	22.69	16.60
West	434.7	570.2	719.4	9.25	9.98	10.63	31.16	26.16
Central City of Large Metro								
Northeast	421.0	481.3	560.9	8.96	8.43	8.29	14.32	16.56
South	293.3	365.7	438.9	6.24	6.40	6.49	24.65	20.02
North Central	376.0	436.4	502.7	8.00	7.64	7.43	16.08	15.19
West	462.8	533.8	664.3	9.85	9.35	9.82	15.35	24.45

Table 6. Projected Manufacturing Jobs Assuming Current Policies Continue, 1987-2005

Area	Manufacturing Jobs (thou.)			Mftg Jobs as a % of U.S.			Mftg Jobs Change (%)	
	1987	1996	2005	1987	1996	2005	1996/1987	2005/1996
United States	19,575	18,841	17,966	100.00	100.00	100.00	-3.75	-4.64
Rural-Urban County Groupings of the U.S.								
Nonmetro Not Adjacent to Metro	1,615	1,787	1,741	8.25	9.48	9.69	10.65	-2.57
Nonmetro Adjacent to Metro	2,438	2,625	2,511	12.45	13.93	13.98	7.67	-4.34
Metro Other Than Central City	9,800	9,516	8,954	50.06	50.51	49.84	-2.90	-5.91
Central City of Large Metro	5,722	4,914	4,759	29.23	26.08	26.49	-14.12	-3.15
Sub-National Regions of the U.S.								
Northeast	32,020	33,779	37,781	163.58	179.28	210.29	5.49	11.85
South	39,221	46,701	51,431	200.36	247.87	286.27	19.07	10.13
North Central	31,535	36,146	39,461	161.10	191.85	219.64	14.62	9.17
West	27,220	32,266	37,670	139.05	171.25	209.67	18.54	16.75
County Groupings by Rurality and Region								
Nonmetro Not Adjacent to Metro								
Northeast	1,064	1,187	1,291	5.44	6.30	7.19	11.56	8.76
South	3,807	4,285	4,439	19.45	22.74	24.71	12.56	3.59
North Central	3,794	4,313	4,520	19.38	22.89	25.16	13.68	4.80
West	2,138	2,687	2,979	10.92	14.26	16.58	25.68	10.87
Nonmetro Adjacent to Metro								
Northeast	2,000	2,210	2,480	10.22	11.73	13.80	10.50	12.22
South	5,305	6,019	6,246	27.10	31.95	34.77	13.46	3.77
North Central	3,846	4,437	4,680	19.65	23.55	26.05	15.37	5.48
West	1,396	1,760	1,995	7.13	9.34	11.10	26.07	13.35
Metro Other Than Central City								
Northeast	18,154	19,711	22,046	92.74	104.62	122.71	8.58	11.85
South	21,237	26,030	29,051	108.49	138.16	161.70	22.57	11.61
North Central	13,201	15,707	17,385	67.44	83.37	96.77	18.98	10.68
West	11,025	13,934	16,391	56.32	73.96	91.23	26.39	17.63
Central City of Large Metro								
Northeast	10,802	10,671	11,963	55.18	56.64	66.59	-1.21	12.11
South	8,872	10,368	11,695	45.32	55.03	65.10	16.86	12.80
North Central	10,694	11,688	12,875	54.63	62.03	71.66	9.29	10.16
West	12,660	13,886	16,305	64.67	73.70	90.75	9.68	17.42

and thus cannot be analyzed correctly in isolation. Rural and urban are intimately related. Our analytic frameworks and our mental world images should reflect this.

Analyses of Alternative Policies

We in RUPRI have not yet applied the current version of the models to the analysis of policy alternatives. We are preparing to do a simulation of Medicare cuts used to lower the federal budget deficit or federal taxes. I am currently studying the degree to which rural beneficiaries of Medicare purchase the services of urban health providers. This information will be an important input into the appropriate spatial allocation of the direct impacts of Medicare cuts.

At this point we know, as shown in Table 7, that Medicare payments tend to equal a larger proportion of personal income in rural than urban areas; Medicare payments in Table 7 are allocated to the residence of the beneficiaries in contrast to the location of the provider. These results suggest that cuts in Medicare projected spending will have greater adverse effects in rural than urban areas. However, the forces associated with the final outcome are sufficiently complex, as outlined in this paper, that the results of the analysis are not a foregone conclusion. Decision makers need this information. We should provide it to them.

Table 7. Medicare Payments Relative to Personal Income, 1993, percent

	Sub-National Region of the U.S.				
	N.E.	South	N.C.	West	Total
Nonmetro	3.25	4.05	3.29	2.94	3.53
Not Adjacent	3.18	4.04	3.44	2.45	3.42
Adjacent	3.29	4.05	3.16	3.74	3.61
Metro	2.66	2.64	2.34	2.22	2.48
Not Cen City	2.47	2.77	2.27	2.09	2.45
Central City	2.98	2.32	2.43	2.35	2.54
Total	2.71	2.95	2.54	2.30	2.65

Sources: Medicare payments from Office of the Actuary, HCFA, with further manipulations by RUPRI; personal income from BEA.

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TOPICS IN FORECASTING

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Economic Research Service, U.S. Department of Agriculture

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Ted Covey, Economic Research Service
U.S. Department of Agriculture

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David Torgerson and John Jinkins, Economic Research Service
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A Revised Phase Plane Model of the Business Cycle,
Foster Morrison and Nancy L. Morrison
Turtle Hollow Associates, Inc.

The Educational Requirements of Jobs: A New way of Looking at Training Needs (Abstract),
Darrel Patrick Wash, Bureau of Labor Statistics
U.S. Department of Labor

FORECASTING FARM NONREAL ESTATE LOAN RATES: THE BASIS APPROACH

Ted Covey
Economic Research Service
U.S. Department of Agriculture

"Basis" is the difference between a commodity's cash price for immediate local delivery (spot price) and its nearby futures price:

(1) BASIS = SPOT PRICE - FUTURES PRICE

There exist as many bases as there are local cash markets for that commodity. Given that futures-cash price relationships change daily, a commodity's basis has both a regional and temporal aspect, differing with respect to time and location. The futures price is that commodity's nearby futures price which will expire at least one month following the month of occurrence of the local spot price.

Farmers will use their average basis for a particular period to make a forecast of their future basis, called the expected basis. For example, if the average local basis for the past three years (1994, 1995, and 1996) for the first week in August was 103 cents per bushel, then the expected basis for the first week of August 1997 for that local cash market is 103 cents per bushel. Methods of calculating the average and therefore expected basis vary; and there is no empirically demonstrated superior approach.

On the day of the forecast, the farmer uses that day's settle futures price FP for the delivery month immediately following the anticipated future marketing month and adds his expected basis E(B) to calculate a predicted spot price E(SP):

(2) $E(SP) = FP + E(B)$

For example, suppose on May 1, 1997, a farmer wishes to forecast his local spot price for corn for the first week November 1997, a possible marketing date. If his past average basis for the first week in November is -7 cents per bushel and the May 1, 1997 corn settle futures price for December 1997 delivery is 269 cents per bushel, then his forecasted spot price for the first week in November 1997 is:

262 cents/bu. = 269 cents/bu. -7 cents/ bu.

This approach has been advocated and extensively used to forecast agricultural product prices (Peck; Hauser et al.; Irwin et al.; Liu et al; Howard; McDonald and Hein; Kamara; Fama and French; French).

This paper will evaluate whether this approach may be useful in forecasting the price of debt in agricultural credit markets.

Method

Using the basis forecast approach developed in commodity markets as an analogy, the equation for forecasting interest rates on farm loans is:

(3) $E(LR) = FY + E(B)$

or the expected farm loan rate E(LR) is equal to the yield calculated from the nearby interest rate futures price FY plus the expected nearby basis E(B).

Data for spot prices will consist of quarterly average effective interest rates on new nonreal estate farm loans (all loans) made by commercial agricultural banks. Agricultural banks are those that have a proportion of farm loans (both real plus nonreal estate) to total loans that is greater than the unweighted average of all commercial banks (usually around 16%) from 1977-1994. These rates are taken from a quarterly survey conducted by the Federal Reserve on the first full week of the second month of each quarter.

The nearby futures price consists of the expected yield calculated from the settle price for the U.S. T-bill futures contract (International Monetary Market of the Chicago Mercantile Exchange) for delivery in the month following the month of the Fed's farm loan rate survey. This settle futures price and yield is based on the average settle futures price for the 5 days of the first full week of the second month of each quarter, concurrent with the Fed's survey. For a simple example of the method of calculating the expected futures yield FY see Chance pp. 302-304.

A basis series for each quarter is calculated by subtracting the interest rate on nonreal estate loans for a particular quarter from the expected futures yield calculated for that quarter. The historical basis series is then used to calculate an average and therefore expected basis E(B) series.

Two methods of calculating the average basis will be used; each generating a different expected basis and therefore a different expected loan rate. The first approach will calculate the expected basis as an average of the four bases for the four quarters previous to the forecasted quarter. For example, the average of the bases of the four quarters for 1990 is used as the expected basis for the first quarter of 1991.

The second approach uses last year's actual or realized basis for the same quarter as the expected basis for that quarter this year. For example, the basis observed in the first quarter of 1990 is the expected basis for the first quarter of 1991.

These two approaches are based on commonly used methods of calculating an expected basis in agricultural commodity markets.

As an example of calculating an expected loan rate E(LR) for the next quarter, assume it is the third week in October 1994 and the first approach is used to calculate an expected basis E(B). If in the fourth quarter of 1994 the average of the last 4 quarters' (i.e. all 4 quarters of 1994) bases is 2.85% (= E(B)) and the settle future price on that day for March 1995 T-bills gives a yield of 5.75% (= FY), then that day' forecast for the 1995 first quarter loan rate E(LR) is:

$$8.6\% = 5.75\% + 2.85\%$$

The two different approaches to calculating an expected basis allowing testing two different futures or basis forecasting models. The forecasts generated by these two basis models (BAVG and BLAG) will be contrasted to forecasts issued by: 1) NAIVE: a naive model where next quarter's loan rate is the same as this quarter's; 2) TREND: a "trend is your friend" model where next quarter's loan rate is equal to this quarter's loan rate plus the change between this quarter and last quarter; and 3) COMP: a composite model with it's forecasts generated as an unweighted average of the forecasts of the four other models.

The NAIVE and TREND models rely solely on information contained in cash prices. The two basis models rely on the relationship between the cash and futures market. Comparing the forecast errors between the cash only (NAIVE and TREND) vs. cash and futures (BLAG and BAVG) models allows a test of whether futures can contribute to price discovery in farm loan markets.

A total of 68 out-of-sample forecasts will be issued by each of the 5 forecast models starting with the first quarter of 1978 through the fourth quarter of 1994.

Forecast accuracy will be evaluated by standard statistical methods: root mean squared error (rmse), mean absolute error (mae), mean absolute percentage error (mape), mean forecast error (mfe), and the range of the forecast error of each model (range).

Results

Table 1 shows the rankings of the 5 different models based on the different statistical results calculated using the 68 out-of-sample forecasts generated by each model for the period 1978:1-1994:4.

The BAVG model (the model which used a moving average of the past four quarterly bases as the expected basis) issued the "best" forecasts based on three of the five forecast criteria: range, rmse, and mape. The TREND model placed first in mfe, and the composite model placed first on the basis of mae.

With all 5 forecast criteria are considered together (averaged and assigned equal weights), COMP issues the best forecasts, while the best-performing futures model BAVG still outperforms the best performing nonfutures model NAIVE.

Conclusions

The superior forecast performance of the model relying on futures information BAVG over the best forecast model relying solely on information in cash prices NAIVE suggest that futures plays a price discovery role in farm loan markets.

Future research should consider the role of interest rate expectations in affecting farmer financial decision-making, the costs to farmers of forecast error, and how forecasts relying on futures might reduce those costs by generating better-informed credit decisions.

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Table 1. Rankings of Forecast Models

	Models				
	NAIVE	TREND	BAVG	BLAG	COMP
Criteria:					
range	2	5	1	4	3
rmse	3	5	1	4	2
mfe	4	1	5	3	2
mae	2	4	3	5	1
mape	3	4	1	5	2
overall	3	4	2	5	1

The "overall" criteria is based on the average of the other 5 criteria, each weighted equally. The numbers 1-5 ranks each model on its forecast error relative to the other 5 models under a particular forecast error criteria. A "1" indicates the smallest forecast error, a "5" indicates the largest forecast error.

REVISING THE PRODUCER PRICES PAID BY FARMERS FORECASTING SYSTEM

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Summary

The prices paid by farmers ten-year-ahead projection equations had last been estimated in the early 1990s. The Economic Research Service (ERS) revised this system using expert judgment and regression. We describe how the revision was done, focusing on the fertilizer and fuel price equations. The revised fertilizer price and fuel price equations are superior, in forecast accuracy, to the associated ARIMA (autoregressive integrated moving average) and the old equation. For fuel prices, the superiority of the new regression equation to the optimal ARIMA evaporates at the end of the out-of-sample forecasting period.

Introduction

The aggregate prices paid by farmers index and its subindices are forecast by the ERS of USDA as part of the ten-year-ahead President's Budget baseline forecasting process. The index is constructed like the Bureau of Labor Statistics (BLS) producer price index (for the items used in farm production.) In particular, the prices paid by farmers subindices are used in forecasting farm production expenses. The National Agricultural Statistical Service (NASS) of USDA, the agency which produces the historical values for these indices, reformulated most of the subindices when changing the benchmark year to 1992 from 1977. For example, some of the prices which had been taken from the NASS survey of farmers for *Agricultural Prices* were instead taken from BLS's PPI price series. As a result of the rebenchmarking and the change in estimation procedure, the statistical properties of the prices paid by farmers (PPF) subindices changed drastically. For this reason, ERS reestimated the prices paid forecasting equations of the 16 sub-components of the index of prices paid by farmers. We describe the equation revision, focusing on the prices paid for fertilizer (PPFERT) and the prices paid for fuel (PPFUEL) forecast equations.

The criteria for the new forecasting equations were:

(1) the exogenous variables had to be available from the USDA baseline process, the forecasting activity to which the new equations were to be added.

(2) the equations should pass the phone call (PC) test for reasonable structure. As forecasts are inevitably in error, it is desirable to easily explain those errors in terms of changes in variables apparently tied to the relevant farmers prices paid index when the phone calls come. The economics consistent with the equations had to be simple and transparent.

(3) as a Government agency forecast simplicity and transparency of methodology were important.

(4) the forecasting equations should produce forecasts superior to those obtained from a simple ARIMA model.

(5) the equations had to be operational for the summer 1997 baseline and documented in the June 1997 issue of the *Agricultural Inputs and Finance Situation and Outlook Report*.

To meet these objectives John Jinkins of the Rural Economy Division (RED) of ERS created a committee including representatives from NASS and the parts of ERS involved in the budget baseline process. Committee members Jinkins and Torgerson estimated the new equations. At each committee meeting three to five equations were reviewed and critiqued. As a result of committee discussion, some equations were again re-estimated.

To fulfill criteria 1 to 3, and recognizing that the revised price index data were limited to annual series from 1974 to 1995, it was decided that all the new equations were to be linear, log-linear or in percentage change. C.W.J. Granger and Paul Newbold in *Forecasting Economic Time Series* (GN) criticized the use of linear regressions for forecasting because of the problem of spurious correlation. A regression equation could show a good in-sample fit as measured by R^2, and perform miserably in out-of-sample forecasting.

The example GN presented was a regression of one random walk on another random walk resulting in good in-sample R2 but a poor forecasting performance out-of-sample. We guard against this problem by the PC criteria and the use of out-of-sample testing. Equations which contain variables related by economic theory appear to be somewhat resistant to the spurious correlation problem. Table 1 presents the functional form of all the resulting forecasting equations.

To illustrate the forecast reestimation we review the development of two of the more important forecasting equations. As data revisions had only been back to 1974, we backcasted using the percent change in the old indices back to 1970. We then estimated the equations over 1970-1990 to reserve the 1991 to 1996 observations for out-of-sample testing. (For the fuel price equation, the 1988 to 1996 period was reserved for out-of-sample testing to mitigate the problems related to the volatile oil market of 1990 and 1991. The panel thought it unlikely that the next twenty years would have three oil supply shocks.) The old set of equations, estimated in the early 1990s, was the second benchmark. Those equations, given the large data revisions for many of the price subindices, had to be revised to maintain forecast credibility.

There are three types of prices paid by farmers equations: (1) prices determined by farm sector supply and demand (2) prices determined by demand from the farm sector and supply from the general economy and (3) prices determined by the general economy. The old feed price paid equation, is close to an accounting identity, given the abundance of commodity price data forecasted in the budget baseline. With the major feed ingredient prices as explanatory variables, the equation error term reflects markup changes and other random shocks which would not be easily improved upon. For the feed price equation it was only necessary to re-estimate the old equation with new data as the forecasts based on actual grain prices were excellent.

Other prices, such as the fertilizer prices paid index (PPFERT) reflect an interplay of the farm sector and overall economy. Fertilizer prices are demand driven by farm commodity prices, acreage decisions, and other specifically agricultural variables. The supply side is strongly influenced by the price of energy, as natural gas is the largest variable cost in producing ammonia-based fertilizers. We examine this equation in detail.

There is a widespread recognition of macro-prices, prices which agriculture is subject to but are determined by economy-wide forces. Using less than 3 percent of total liquid fuels, U.S. farming has small influence on liquid fuel prices. The fuel prices paid by farmers index (PPFUEL) is the macro-price examined in detail.

Modus Operandi

We present the results of our search for "good" forecasting equations for fertilizer and fuel prices in table 2 and figure 1, and table 3 and figure 2, respectively. Each forecast equation development started with estimation of an autoregressive moving average (ARMA) model of the specific prices paid subindex. The dependent variable is the level of the variable in question. The independent variables can be thought of as lags of the variable reflected in the moving average (MA) terms; the correlations of the dependent variable with itself across time periods are reflected in the autoregressive (AR) terms. A maximum likelihood estimation is done to compute these estimates. For a sample this small (21 observations), only first and second order MA and AR terms were estimated. Any standard econometrics package such as SAS or EVIEWS can be used to estimate AR and MA coefficients and select the optimal orders for the AR and MA, concomitantly.

The problem with the above procedure is that economic variables seldom pass the statistical tests for stationarity as required for the optimality of the ARMA estimator. The first assumption for stationarity to hold is that the mean of the variable, say the fertilizer price index, is constant. The second stationarity assumption is that the covariance between fertilizer prices in various periods depends only on the differences between the time periods. Most of the indices of prices paid by farmers are not stationary as measured by standard statistical tests.

The standard operating procedure is to difference a variable until the transformed (differenced) variable passes the standard stationarity test--the augmented Dickey-Fuller test (DFT). Seldom do economic variables need to be differenced more then twice to attain stationarity. Why do an ARMA as the DFT on undifferenced data are very likely to reject stationarity and an ARMA model which incorrectly assumed stationarity would generally do quite poorly in forecasting, with rapidly increasing forecast error as the forecast period lengthened? The DFT for stationarity is not a very powerful test so that it will "often" reject a series which is actually stationary. Further, the ARMA estimation process will be an independent test for some kinds of nonstationarity. Finally, running an

ARMA is easier than running a regression and often gives some insight into the process which generated the data. We refer to the estimation of ARMA on levels of a variable explained as naive ARMA. All the orders of integration were determined by DFTs.

The next step was to estimate an ARMA on the integrated series. For both fuel and fertilizer prices, differencing once made the series stationary. The difference between the current fertilizer price paid and the previous price paid is the appropriate variable for ARMA estimation. We will refer to this as the ARIMA model of fertilizer prices--as the once differenced fertilizer price is consistent with stationarity. To get an actual forecast, one simply adds the ARIMA estimated difference to the series value in the previous period.

To give the old forecasting equation a fair chance, we estimated the reduced form with the same variables and functional form as the old forecasting equation using new data. We label this old/new in tables 2 and 3 below.

The new specification of the forecasting equations was developed by committee. The small amounts of data, the desire to be understandable, and time constraints prevented any use of sophisticated techniques. The shortage of data was the binding constraint. (The cutting room floor models which were rejected for very bad Durbin-Watson statistics and bad forecasting performances are not included here.)

We should point out that none of these regression models was the explicit result of taking structural form models of supply and demand and solving them explicitly for a specific reduced form. In using the term structural models we simply mean regression equations with variables which are apparently related to the prices paid index.

And of course, the out-of-sample model forecast performance is important in sorting the wheat from the chaff. A major contribution of the time series literature is emphasizing out-of-sample forecasting as a way to validate economic models. Many would go even further and say that if a model does not forecast well out-of-sample it is not a valid reflection of reality.

Fertilizer Prices Paid Forecast Equation

PPFERT is the variable forecasted. Table 2 reports the standard statistics for each competing forecasting equation. Greater detail is available in tables 2a through 2h, available from the authors on request. Figure 1 graphically depicts the competing forecast equations. A result of the DFTs is that the regression equations were not balanced in the sense of all variables in the regression equation having the same order of integration. In particular, the crude oil price (RAC) in the new regression equation (PPFERTFNEW) is integrated of degree 2. That is, the RAC has to be differenced and that result differenced again to be consistent with stationarity, as tested by the DFT. The standard t-tests implicitly assume both the dependent and independent variables are integrated of the same order. In this case they are not, since PPFERT is integrated of degree one. So one can get a spurious correlation problem by including variables not related to the forecasted variable in the forecasting equation even though the t-test says they are related. That is why GN note that having variables of different orders within a regression equation makes for potential problems for use in out-of-sample forecasting.

The use of out-of-sample forecasting should mitigate the potential problem of an equation with a good in-sample fit producing a bad forecast.

The ARMA (PPFERTFARMA) summary statistics verify the results of DFT for PPFERT. Indeed not only is the price index not stationary but the estimated AR coefficient is slightly above one, indicating unstable behavior, likely that of a random walk. Note that the mseout is larger for the old forecast equation estimated with the new data (labeled old/new in Table 2 with equation name PPFERTFOLD in Figure 1) than for PPFERTFARMA. The old/old regression had a non significant constant while big8acres (the sum of the acreage of the eight highest acreage planted crops) is close to significant. The old equation with new data had the situations reversed. The instability inherent in such drastic changes in which variables are apparently significant greatly detracts from the confidence one places in either equation and may well reflect a spurious correlation problem. The evidence against the old/new formulation is overwhelming when the mseout is sharply in favor of the naive ARMA and the basic coefficients are unstable. Further, the lagged dependent variable (PPFERT(-1)) tends to bias the DW upward as well as make for more potential out-of-sample forecast error Getting rid of lagged dependent variables was a major operational goal of updating the forecasting equations. The old fertilizer price equation with new data performed very poorly in terms of R^2 if PPFERT(-1) (the actual fertilizer index lagged one period) was omitted, revealing that an equation restructuring necessary.

On several grounds then, the competition is between the new regression equation (PPFERTFNEW) and the first difference ARIMA formulation (PPFERTARIMA). The big8acre and the constant were insignificant in an equation with the average of the current market year and prior market year price of corn averaged (avg(compr& compr(-1)). (This gives a flavor of forecasting with expected values since fertilizer is purchased prior to the marketing year corn price being determined. It is not fully consitent with using expectaions in a more rigorous sense since the expected corn price is not determined endogenously in the estimated model.) And the crude oil price (RAC) was significant with those variables while the log of the real crude oil price term was not. So the RAC and average corn price, over the current and prior marketing year, were the first two variables selected for the new forecasting equation.

In the committee discussions of the above preliminary version of the new forecasting equation, it was pointed out that there had been an improvement in fertilizer input quality over time. Further, it was noted at the time most fertilizer was purchased the average corn price for the current marketing year was not known.

We dealt with the fertilizer quality improvement by adding a simple time trend which proved superior in terms of out-of-sample forecasting to using any of the standard inflation variables. This change also made the R^2 comparable to the old equation's R^2. The final form of the new regression equation then had the current crude oil price, the average of the expected corn price and the previous marketing year corn price, and a time trend. Since corn prices are forecast in the baseline, the forecasted corn price was used in the actual fertilizer price forecasts. The superior mseout of the new structural equation is tabulated in Table 2 and shown graphically as PPFERTFNEW in Figure 1. Either representation dramatically demonstrates the striking forecasting superiority of the new equation relative to the other candidates.

Since the mseout of an equation differenced is not comparable with a level equation, it is necessary to look at the actual out-of-sample forecast to determine which formulation is superior in forecasting. Figure 1 graphically shows the clear superiority of the new structural equation over even the best ARIMA. The moral of this story is that a good structural equation beats an ARIMA. (But a bad structural equation can be worse than a naive ARMA as the above comparison of PPFERTFARMA and PPFERTFOLD seen in Figure 1 clearly demonstrate.)

Farm Fuel Prices Paid Index Forecast

PPFUEL is the variable to be forecasted. Table 3 summarizes the standard statistics for alternative forecasting equations. More detail is in tables 3a through 3h, available from the authors on request. Figure 2 graphically depicts the comparative forecasts. As above, all variables in the structural equations do not have the same order of integration. Again, the crude oil price (RAC) and price paid by farmers for fuel (PPFUEL) are integrated of degree 2 and 1 respectively. The lack of order consistency of dependent and independent variables could mean poor out-of-sample forecasting for both the old and new regression equations.

The ARMA (PPFUELFARMA) supports the results of DFT for the fuel price index. The fuel price index is not stationary and the estimated AR coefficient is above one, indicating explosively unstable behavior, likely a random walk. Note that the mean-squared error in the out of forecast period (mseout) for the ARMA is larger than that statistic for the old forecast equation estimated with the new data (labeled old/new). The old/old regression had decent t-statistics for all coefficients. The old forecast structure for fuel prices may be superior in forecasting to the naive ARMA in sharp contrast to the fertilizer price situation. Figure 2 indicates both the old equation with new data (PPFUELFOLD) and the ARMA are quite bad forecasting models relative to the ARIMA or the new regression model. Further, the farmers prices paid fuel index lagged one year (PPFUELl(-1)) tends to bias the Durbin-Watson upward. Yet even so the measured Durbin-Watson is smaller than the R^2. This strongly suggests out-of-sample forecasting problems. As in the case of the fertilizer price forecast equation, finding a replacement for the lagged dependent variable was a major goal. (Some analysts would have appropriately used the Durbin h test in the presence of lagged dependent variables to test for first order autocorrelation. We chose not to since we were getting rid of lagged endogenous variables anyway. Forecasting out ten years with lagged dependent variables is problematic at best and we did not expect to have any final equation with lagged endogenous variables.)

In summary, ARMA (PPFUELFARMA) is bad and the old/new equation (PPFUELFOLD) is only marginally better in a forecasting sense. This reflects the typical situation in attempting to forecast a number of years out using with ARMAs on undifferenced data and regression equations with lagged dependent variables.

The new equation reported in Table 3 and depicted in Figure 2 as PPFUELFNEW is not the first new equation. Having PPFUEL as a function of RAC and PPI lagged one period for 1970 to 1990 had R^2 go up marginally compared to the old equation's R^2. But the lagged endogenous variable is no longer needed and the Durbin-Watson has improved. Further, without the lagged endogenous variable, the Durbin-Watson is a valid test for serial correlation. Still the Durbin-Watson was smaller than the R^2, making forecasting problematic as this equation fits the typical spurious correlation pattern detailed in GN. To mitigate this and the problem of the unstable oil market during 1990 and 1991 we shortened the estimation period to 1970-1987, and reserved a larger out-of-sample period (1988 to 1996) to test the reestimated equation.

The in-sample problems remain. The Durbin-Watson is smaller than the R^2. But the coefficients of RAC and PPI(-1) continue to be significant and the mseout is noticeably lower than the ARIMA.

In some sense, the structural fuel price forecasting equation is more satisfactory than analogous fuel price equation. Again, the crude oil price (RAC) replaces the natural log of the real crude oil price. The PPI lagged one year (PPI(-1)) is superior to a time trend in projecting the tendency of fuel prices to rise over time. The use of the PPI makes it far easier to interpret the fuel price equation than a time trend does, as prior inflation is a partial explanation of higher fuel prices today.

The ARIMA model of the first difference of the fuel price is an improvement over the naive ARMA. Again, the gain is not as dramatic as in the case of fertilizer prices. Neither the AR nor MA terms are statistically significant. This is not crucial, as t-statistics are not as definitive in an ARIMA context as they are in the regression framework.

The new regression equation and the first difference ARIMA formulation are again the apparent competitors. Since the mseout of an equation differenced is not comparable with a level equation one needs to look at the actual forecasts to see whether the new equation or the ARIMA is superior in forecasting. Figure 2 reflects a better out-of-sample forecasting record for the improved structural fuel price equation (PPFUELFNEW) relative to the ARIMA (PPFUELFARIMA). Note the forecast superiority is lost at the end of the forecast period, 1994-1996. Nevertheless, because of simplicity, interpretability, and overall forecast superiority the new structural equation is the best choice, despite the marginal forecast victory. Using criteria 1 to 3 the margin of victory of the new fuel price structural model over the ARIMA is larger than in the fertilizer price situation.

Implications

With some effort, it is possible to beat ARIMA in forecasting. When human capital is lost it sometimes is possible to partly recover by taking a fresh look at the data and in a fairly economical fashion use expert judgment in the formulation of the equations instead of the forecasting process directly. The involvement of the producers of the prices paid indices and as well as the users of the prices paid index forecasts made the equation revision process feasible.

Table 1--Forecast farm prices paid indices equation structure

For this prices paid index:	ERS will consider the outlook for these items when making the 1998 forecast: (mya = marketing year average 1/)	An increase in this item will have this effect on the forecast:
feed	ratio of 1998 corn mya price to 1997 corn mya price	increase
	ratio of 1997 corn mya price to 1996 corn mya price	increase
	ratio of 1997 soy meal mya price to 1996 soy meal mya price	increase
	ratio of 1998 all hay mya price to 1997 all hay mya price	increase
livestock & poultry	1998 feeder steer price, 750-800 pounds, Oklahoma City	increase
	1997 feeder steer price, 750-800 pounds, Oklahoma City	increase
	1998 milk price	increase
	1997 corn mya price	decrease
seeds	sum of 1997 acres planted to corn, wheat, and soybeans	increase
	1998 inflation as measured by the producer price index	increase
	1997 corn yield	decrease
fertilizer	1998 crude oil price	increase
	average of 1998 and 1997 corn mya prices	increase
	trend over time measured as a constant annual increase	increase
agricultural chemicals	average of 1998 and 1997 corn mya prices	increase
	1997 fertilizer producer price index	increase
	trend over time measured as a constant annual increase	increase
	average of 1998 and 1997 crude oil prices	decrease
fuels	1998 crude oil price	increase
	1997 inflation as measured by the producer price index	increase
supplies & repairs	1998 inflation as measured by the producer price index	increase
autos & trucks	1997 inflation as measured by consumer price index	increase
farm machinery	1998 inflation as measured by the producer price index	increase
building material	1998 inflation as measured by the producer price index	increase
farm services	1998 inflation as measured by consumer price index	increase
rent	1998 land prices	increase
	sum of 1998 values of production of corn, soybeans, & wheat	increase
interest	1998 Moody's AAA bond rate	increase
	1998 prime rate	increase
taxes	1998 inflation as measured by consumer price index	increase
wage rates	1998 average hourly earnings in nonagricultural industries	increase
	trend over time measured as a constant annual increase	increase

1/ corn marketing year begins September 1, soy meal marketing year begins October 1, hay marketing year begins May 1

Table 2 Fertilizer Price Index-Forecast Comparison

	Constant	PPFERT(-1)	Ln (real RAC)	RAC	Big 8 acres	Avg(compr& compr(-1)	Time trend	AR(1)	MA(1)	Durbin Watson	R^2	Mseot
Integration order		1	2	2	1	0	NA					
ARMA								1.01	-0.65	2.23	0.84	144.85
t-stats								25.14	3.60			
								nonstationary				
ARIMA-first difference								-0.40	0.97	1.92	0.21	62.06
t-stats								-1.66	20.26			
								inverted roots				
								-0.4	-0.97			
Old/old	-1.20	0.60	0.11		0.50					NA	0.92	NA
t-stats	-0.58	6.50	1.60		1.70							
Old/new	99.76	0.73	17.80		-0.18					1.69	0.89	525.79
t-stats	1.71	8.69	2.43		-0.98							
New	none			0.61		19.75	2.12			1.53	0.93	20.26
t-stats				3.10		11.03	8.10					

Table 3 Fuel Price Index-Forecast Comparison

	Constant	PPFUEL(-1)	Ln (real RAC)	RAC	PPI(-1)	AR-term	MA-term	Durbin Watson	R^2	Mseout
Integration order		1	2	2	1					
ARMA						1.04	0.59	1.87	0.93	3.77
t-stats						25.34	3.11			
						nonstationary				
ARIMA-first difference						0.36	0.33	1.87	0.16	2.36
t-stats						0.39	0.41			
						inverted roots				
						0.36	-0.33			
Old/old	1.76	0.61	0.05					NA	0.89	NA
t-stats	3.03	4.67	1.84							
Old/new	27.92	0.88	10.27					0.83	0.93	7.22
t-stats	3.21	13.18	2.67							
New	-9.78			1.31	0.65			0.92	0.99	1.46
t-stats	-4.38			3.10	8.10					

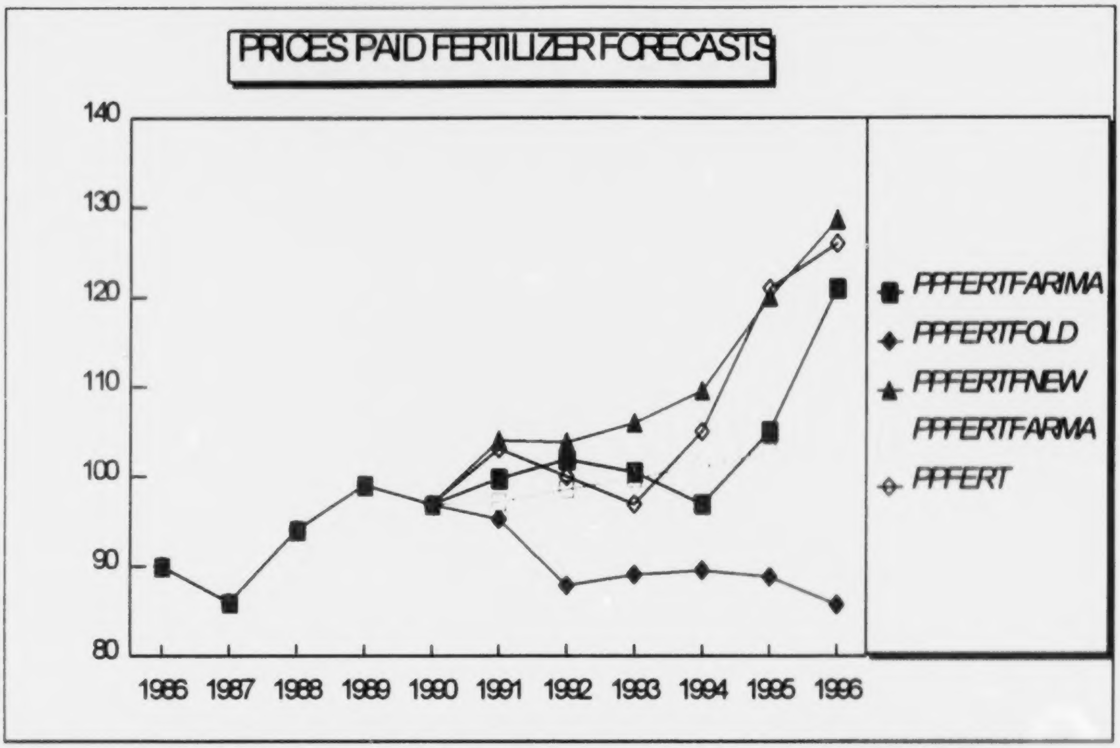

Figure 1 NEW FERTILIZER PRICE REGRESSION OUT FORECASTS ARIMA

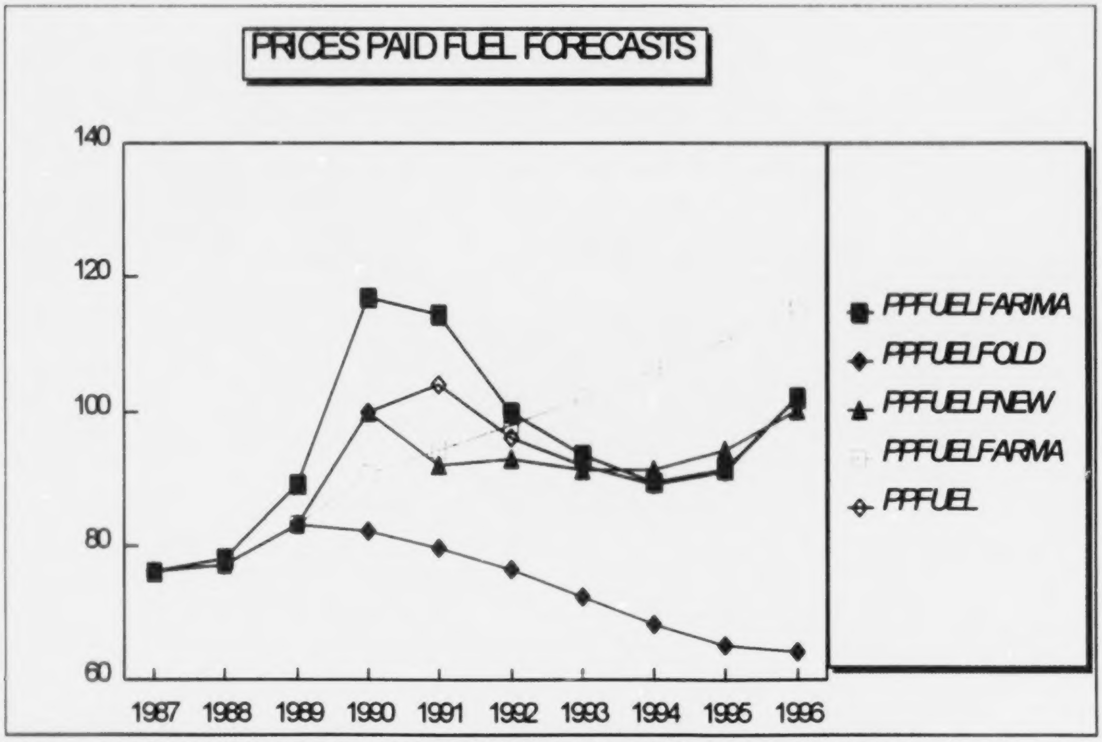

Figure 2 NEW FUEL PRICE REGRESSION OUT FORECASTS ARIMA

A REVISED PHASE PLANE MODEL OF THE BUSINESS CYCLE

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1. MACROECONOMIC FORECASTING

The overwhelming majority of macroeconomic data series are produced by federal agencies, mostly ones in USDoC (U.S. Department of Commerce) and in the Department of Labor. All macroeconomic forecasters, whether in government, academe, or the private sector, are highly dependent upon these data series.

In 1995 USDoC began a process of privatizing production of the indices of leading, coincident, and lagging indicators. Changes resulting from this action did provide additional verification of the robustness of a model based on these indices, but they also raised serious questions about the difficulties individuals and small organizations will have in accessing this data economically and in a timely manner.

2. WHAT ARE BUSINESS CYCLES?

An awareness of cycles other than the daily alternation of night and day and the annual progression of the seasons has existed throughout history. The biblical story of Joseph, which straddles Genesis and Exodus, is one example [Genesis 41, 42, 47; Exodus 1, 13; Anderson, 1966].

By interpreting the dreams of Pharaoh to mean that 7 years of abundant harvests would be followed by 7 years of famine conditions, Joseph warned the Egyptians to store enough grain from the good years to cover the shortfall in the bad ones. Biblical scholars place the time frame at about 1635 BCE, but there are no supporting materials in any known Egyptian sources. Even so, the story demonstrates an early awareness of climatic cycles and how these can affect the economy and politics.

Joseph rose to high positions in the Egyptian government, but his political career came to an abrupt end with the reign of a new Pharaoh. Eventually the Hebrews departed from Egypt, bearing the bones of Joseph with them. This shows how changing political and social conditions can alter the situation of federal forecasters. Recent changes have not been so drastic, but there are numerous challenges for forecasters, whether in the government or not, who use federal data and services.

Collection of detailed macroeconomic data did not begin in the United States until after World War II. This, however, had not prevented the launching of economics as an academic discipline, beginning with the work of Adam Smith (1723-1790) [Samuelson & Temin, 1976].

In the depths of the Great Depression, Edward R. Dewey, then Chief Economic Analyst at USDoC, was assigned the task of discovering what had caused this economic catastrophe. With this began his decades long study of cycles, which produced a large number of publications [Dewey, 1970; Dewey & Mandino, 1971].

Dewey collected and analyzed a huge amount of data, some of it going as far back as the Middle Ages. What he lacked, however, were some of the necessary tools developed in more recent decades. Computers had become common by 1960, but they were extremely expensive and available only to private and public organizations with large budgets; this began to changed in 1980.

Nonlinear feedbacks, a possible cause of cycles, were little known except to a few specialists. Jay Forrester [1961] founded a specialty called system dynamics, which used nonlinear ODEs (ordinary differential equations) and mainframe computers to model industrial and economic systems.

However, chaos and rounding errors, and especially their mutual interactions, make numerical solutions of nonlinear ODEs too unstable to be useful for forecasting. Whether such models are really any better qualitatively for policy analysis than "back of the envelope" calculations is debatable. System dynamics is in a stall [Wils, 1988].

Time series methods are quite suitable for analyzing and forecasting what might be called cycles. They offer a wide variety of algorithms for spectral analysis, correlation analysis, linear filtering, and linear prediction. Various software packages allow one to use all these techniques with little concern as to what they assume and what they imply.

Fortunately, there is a very simple dynamical interpretation of time series analysis. It is a nonhomogeneous linear ODE with constant coefficients where the "right-hand side" is "noise" rather than a smooth, mathematical function [Jordan, 1972]. To be valid, the corresponding homogeneous ODE must have only damped solutions; the real components of its (possibly complex) eigenvalues must be negative. The concept extends readily to systems of equations and to difference equations [Morrison, 1991a].

The dynamical interpretation of a time series model of the business cycle is an aggregate of all markets decaying toward equilibrium. As an economic theory it asserts that the characteristic damping time of this system is significantly longer than the sampling interval [Morrison, 1991b]. This is certainly more plausible than static equilibrium and has many practical ramifications for forecasting and decision making.

3. CONSTRUCTING THE BUSINESS CYCLE MODEL

To construct a business cycle model one needs data. GDP (gross domestic product) data have been available on a quarterly basis since 1947, but the most recent revision by USDoC goes back only to 1959. Some estimates of earlier annual values can be found; the HANDBOOK OF CYCLICAL INDICATORS [1984] lists peaks and troughs of the business cycle back to December 1854.

A far better model can be constructed, however, using the indices of leading and coincident indicators [Morrison & Morrison, 1997]. These not only provide a phase plane plot, they also provide numbers on a monthly basis. Some economists do use the index of lagging indicators in creating forecasts, but we have not incorporated it into our business cycle model.

Due to growth and inflation, a trend must be subtracted from the data, whether it is the GDP or any of the 3 indices. Time series methods implicitly assume the data has a zero mean value. Before detrending, the data must first be converted to logarithms to achieve stationarity. It is percent deviations from the trends that are fairly consistent, not absolute deviations.

For the business cycle and other economic data we have developed the ramp filter as a trend model. It does not change the trend as new data points are added, a problem with polynomial or other multiple regressions. The extrapolation of this trend model is always stable, which is never true of polynomials of degree 2 or higher. And unlike a moving average, the ramp filter trend is not displaced down (up) when the data values are increasing (decreasing) [Morrison & Morrison, 1997].

Since the indices can be forecast with a fair degree of reliability for 2 months ahead, the business cycle model is up to date. Delays in collection and analysis cause the indices to be released about 2 months after the fact. GDP data are not only delayed, but provided only on a quarterly basis.

The phase plane model of the business cycle, with a 1-year forecast, has been published in our newsletter CRITICAL FACTORS since August 1992, when it replaced 3-year forecasts of the 3 indices. A 60-point ramp filter is used for both the trend model and in the forecasts. The ramp filter formulas are given in our earlier paper [Morrison & Morrison, 1997], so anybody can duplicate the historical model.

4. DIMINISHING FEDERAL RESOURCES

During the past two decades or so, users of federal services and data have been faced with growing user fees and, in some cases, loss of access when programs are curtailed or canceled. The private sector has done much the same (recall the road maps that once were free at any gas station) and for the same reason: to save money.

Privatization has been used in attempts to save tax dollars. This may involve contracting out a specific activity or attempting to make an entire agency self-supporting. Users may be disrupted by more than higher fees or loss of the benefit, if competitors do not face similar problems.

In the case of the business cycle model, the anticipated disruptions had been the regular revisions of the indices, especially the ones involving movement of the base year forward in time. A positive aspect of this had been that it demonstrated robustness in the model [Morrison & Morrison, 1997].

In 1995 USDoC announced a plan to turn over the production of the indices to a private organization. There was no contract money for supporting the indices in the future and the successful bidder would incur significant expenses in assuming the responsibility. No mechanism was included in the contract to guarantee future creation and distribution of the indices or to exercise quality control.

Fortunately, a number of highly qualified organizations stepped forward to meet the challenge and they offered bids. The winner was The Conference Board, Inc. (TCB), a well regarded, New York city-based, not-for-profit organization.

From the viewpoint of index users, the privatization process seemed to offer more risks than rewards. TCB might decide to stop producing the indices or it might raise the cost of access. Changes might make the indices better, or it might make them worse. These indices are not just weighted averages and constructing them is an arcane craft.

If production of the indices ceased, it would be feasible to recreate them, since current federal agency plans are to continue production of all the component series. This, however, would entail considerable effort and might create more delays. There is always the possibility of developing new indices, just as there is of making the business cycle model more elaborate, using the index of lagging indicators or other data sources.

5. CHANGES DUE TO PRIVATIZATION

For the data for the month of December 1995, USDoC and The Conference Board collaborated to produce the indices. Then for about a year TCB continued to produce the indices using the established USDoC algorithm. But starting with the values for December 1996, the algorithm was changed along with the base year (advanced from 1987 to 1992).

Two components were removed from the leading index because they seem not to work as well anymore: 1) changes in sensitive materials prices and 2) changes in unfilled orders for durable goods. The yield curve, the difference between the interest rate on 10-year Treasury notes and the federal funds rate, has been added, so that the number of components is 10 rather than 11.

Some economists have been recommending this new statistic and TCB moved quickly to implement the change [Estrella & Mishkin, 1996]. An attractive feature of this data series is that it is easy to collect and unambiguous, like stock market indices. The replaced series required an extensive data collection effort (of many different numbers) and making a lot of assumptions and extrapolations. The USDoC had been rather hesitant in making changes, so this first improvement is due to privatization.

But is the new leading index really better? According to TCB itself, it is a marginal improvement, not a breakthrough. Our business cycle model changed significantly more than it did when USDoC last made a major revision of the indices. (The radial coordinates did drop roughly in half, but the phase angles shifted only by a few degrees.)

Compare the phase plane plot in Figure 1 with the one from our previous paper [Morrison & Morrison, 1997]. The roughly elliptical curve has rotated about 30 degrees counterclockwise, but the major quadrant crossings were virtually the same. The new and revised indices extend back only to 1959 (not 1947), so the revised model itself does not start until December 1963 (the ramp filter trend model requires 60 points from the past). Among the older cycles that can be compared, the most noticeable change is that the dive into the 3rd quadrant during the recession of 1974-75 was not as pronounced.

When USDoC similarly moved the base year for GDP from 1987 to 1992, it also started the new data series with 1959. One reason for cutting series short is that changing economic conditions make it very difficult to compare data from one year with that from another year decades earlier or later. Some indicators that worked well before no longer do. The product mix in GDP has changed significantly. During its final major revision of the indices before privatization, USDoC had used different weighting for two time periods in one of the indices.

As a result of the curtailed time coverage, the business cycle models from the two data series can be cross-checked only for the period 1963-1996. That is 34 years, but it is barely more than the 15-25 years of the Kuznets cycle and much less than the 50-60 years of the Kondratieff wave. This is too little data to determine the statistics of such cycles and thereby verify their existence, let alone construct a theory for their cause. However, it is more than enough to analyze and forecast the typical short-term business cycles of 5-10 years.

Shift	Number
+1	3
0	13
-1	2
-2	0
-3	3
-4	1
Total	22

Table 1. Major quadrant crossings. Shifts in months from old model to new model.

To provide a capsule comparison of the new model with the old one, Table 1 lists the number of major quadrant crossings and the months by which they were shifted. Major crossings exclude those cases where the model stalled near a quadrant boundary and jumped back and forth over it several times. Of the 22 counted, more than half (13) did not shift at all. There are, of course, no possible comparisons for the period 1953-1962 or for 1997.

Shifts in the phase angles for the beginnings and endings of recessions are compared in Table 2. The official dates are designated by the National Bureau of Economic Research (NBER), a private, not-for-profit organization.

The most recent phase plane plot for the business cycle model based on the new indices is given in Figure 1, along with a forecast for more than one year. Numerical values for the phase plane coordinates for the forecast and the past 2 years of observed values are provided in Table 3.

During 1995 the business cycle moved in an orderly way through the 2nd quadrant, apparently heading for the recession-prone 3rd quadrant. However, in February 1996 the model collapsed into the origin and has been bouncing around there ever since.

The dynamical interpretation of time series forecasting tells us that only a strong move in the indices will signal a resumption of activity in the business cycle. Forecasting implicitly sets the "noise" input to its zero expected value, so predictions always have a general tendency to spiral into the origin. The forecasting model is a homogeneous linear ODE with constant coefficients, always having eigenvalues with negative real parts. The variance estimate of the forecast, however, asymptotically approaches the RMS of the "noise," indicating the growing uncertainty of phase information for future values.

Some analysts, buoyed by the soaring stock market, have declared that the business cycle finally has been tamed. Some credit improved information technology and just-in-time delivery with eliminating inventory buildups.

Having seen the apparent successes of Keynesian economists and Federal Reserve micromanagers fall apart during previous decades, we remain skeptical of any claims of permanently taming the business cycle. After all, what magical event occurred in February 1996 to make all this new technology suddenly work to perfection? The reports of Mark Twain's death were greatly exaggerated once; those of the business cycle, many times.

Time Frame	Begin	Z(old)	Z(new)	End	Z(old)	Z(new)
1963-72	12/69	210	214	11/70	238	245
1972-76	11/73	95	111	03/75	219	231
1976-84	01/80	204	212	07/80	228	246
1976-84	07/81	264	273	11/82	307	305
1983-96	07/90	221	233	03/91	241	258

Table 2. Phase angles (Z) in degrees at official (according to National Bureau of Economic Research) beginnings and ends of recessions. Note that the 1976-1984 cycle had an official "double dip" recession.

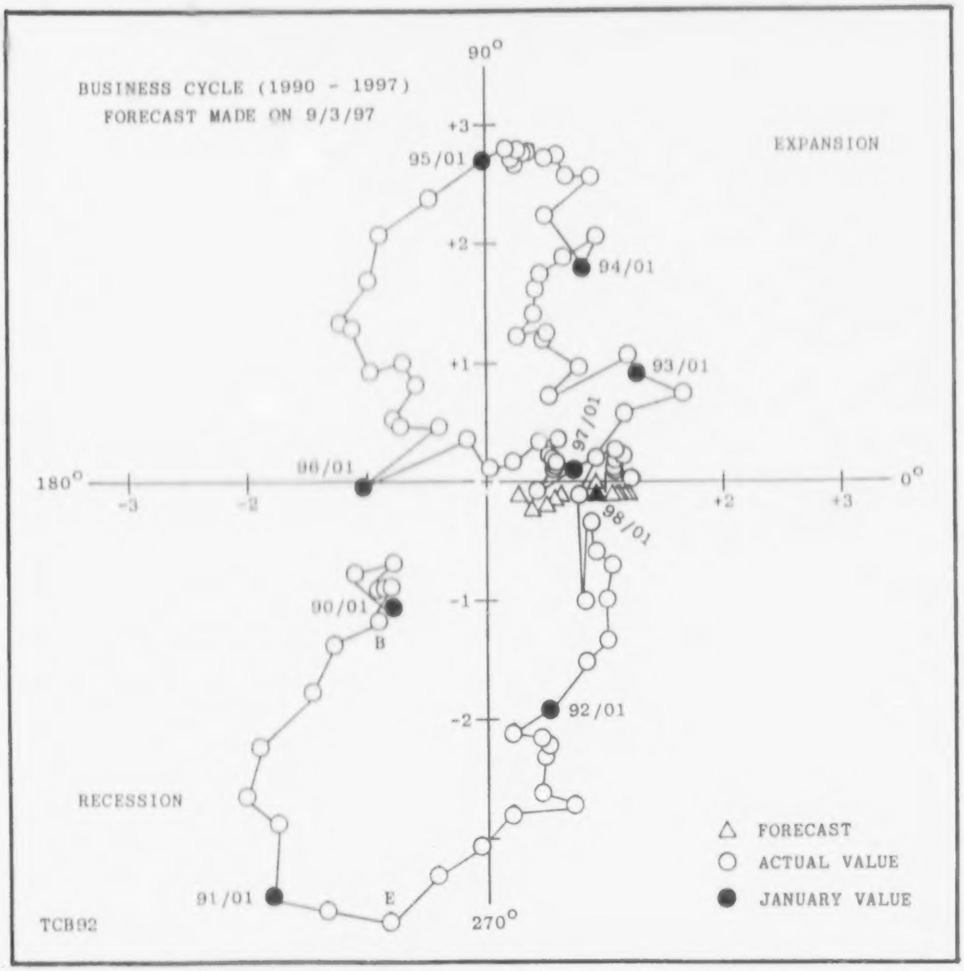

Figure 1. The current cycle with September forecast. The business cycle model is a phase plane plot of detrended leading and coincident indicators, as X- and Y-coordinates, respectively. Normal cycles follow a counterclockwise roughly elliptical path with occasional stalls and reversals. Time is indicated along the cycle path. Expansions occur in the first quadrant (between 0° and 90°) and contractions in the third quadrant (between 180° and 270°). Other angles (second and fourth quadrants) denote transition periods. An "official" (National Bureau of Economic Research) beginning of a recession is indicated by a label "B" and an end by "E."

Table 3. Recent and forecast values for the business cycle state variables. P(L) is the x-coordinate and P(C) is the y-coordinate, which are the percent deviations from the trend of the indices of leading and coincident indicators. R is the radial coordinate and Z the phase angle in degrees; quad is the quadrant of Z.

Date	P(L)	P(C)	R	Z	Quad
OBSERVED					
95/01	-0.023	2.693	2.693	90.5	II
95/02	-0.471	2.387	2.433	101.2	II
95/03	-0.900	2.080	2.266	113.4	II
95/04	-1.020	1.696	1.979	121.0	II
95/05	-1.224	1.320	1.800	132.8	II
95/06	-1.137	1.300	1.727	131.2	II
95/07	-0.961	0.924	1.333	136.1	II
95/08	-0.688	0.998	1.212	124.6	II
95/09	-0.604	0.806	1.007	126.8	II
95/10	-0.778	0.546	0.951	145.0	II
95/11	-0.742	0.480	0.883	147.1	II
95/12	-0.428	0.504	0.661	130.3	II
96/01	-1.041	-0.048	1.042	182.6	III
96/02	-0.142	0.375	0.401	110.7	II
96/03	0.047	0.100	0.111	65.1	I
96/04	0.217	0.173	0.278	38.5	I
96/05	0.462	0.318	0.561	34.6	I
96/06	0.593	0.363	0.696	31.5	I
96/07	0.516	0.239	0.569	24.8	I
96/08	0.545	0.207	0.583	20.8	I
96/09	0.572	0.173	0.597	16.8	I
96/10	0.505	-0.105	0.516	348.2	IV
96/11	0.539	0.051	0.541	5.4	I
96/12	0.581	0.039	0.583	3.8	I
97/01	0.796	0.029	0.797	2.1	I
97/02	1.079	0.259	1.109	13.5	I
97/03	1.152	0.149	1.161	7.4	I
97/04	0.944	0.203	0.966	12.1	I
97/05	1.019	0.009	1.019	0.5	I
97/06	0.999	0.071	1.002	4.1	I
97/07	1.161	-0.033	1.162	358.4	IV
FORECAST					
97/08	1.129	-0.097	1.133	355.1	IV
97/09	1.098	-0.097	1.102	354.9	IV
97/10	1.151	-0.100	1.155	355.1	IV
97/11	1.097	-0.028	1.098	358.5	IV
97/12	1.024	-0.041	1.025	357.7	IV
98/01	0.961	-0.054	0.963	356.8	IV
98/02	0.808	0.014	0.808	1.0	I
98/03	0.682	-0.063	0.685	354.7	IV
98/04	0.644	-0.136	0.658	348.1	IV
98/05	0.523	-0.126	0.538	346.4	IV
98/06	0.407	-0.189	0.448	335.1	IV
98/07	0.305	-0.084	0.316	344.5	IV
98/08	0.204	-0.142	0.248	325.2	IV
98/09	0.107	-0.039	0.114	340.0	IV
98/10	0.014	-0.020	0.024	305.0	IV
98/11	-0.082	-0.079	0.114	224.0	III
98/12	-0.095	-0.059	0.112	211.9	III

6. CONCLUSIONS

This very simple phase plane model of the business cycle has once again demonstrated its robustness and usefulness. It has survived the privatization and revision of the indices used to construct it and it could be maintained as long as the basic data continue to be collected and published in a timely fashion.

We have doubts that collection of the basic data could be privatized. Legal, logistic, and political problems might arise and we have no expertise in even anticipating what they might be. The cost of collecting all macroeconomic data is an insignificant fraction of the federal budget and it seems to us to be necessary for managing that budget and conducting fiscal policy.

These data and the business cycle model can be invaluable to businesses and investors, but too few are inclined to use them. What do people use? Intuition, technical analysis, cycle theories that have more in common with numerology than mathematics, and even astrology. Those without scientific training are more inclined to accept dubious claims of certainty than to try to cope with the reality of forecasting errors that grow relentlessly with time.

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The Educational Requirements of Jobs: A New Way of Looking At Training Needs

Darrel Patrick Wash, Bureau of Labor Statistics, U.S. Department of Labor

This study presents a new way of classifying occupations by training requirements. This more detailed approach, which now covers several different categories of employer-provided training as well as the more traditional academic training categories, is presented, along with a discussion of how it can be combined with previously developed estimates of occupational net replacements to formulate a much clearer picture of future education and training demand.

Concurrent Sessions II

FORECASTING CROP PRICES UNDER NEW FARM LEGISLATION

Chair: Peter A. Riley
Economic Research Service, U.S. Department of Agriculture

Forecasting Crop Prices Under New Farm Legislation,
Peter Riley, Economic Research Service
U.S. Department of Agriculture

Forecasting Annual Farm Prices of U.S. Wheat in a New Policy Era,
Linwood A. Hoffman, James N. Barnes, and Paul C. Westcott,
Economic Research Service
U.S. Department of Agriculture

An Annual Model for Forecasting Corn prices,
Paul C. Westcott, Economic Research Service
U.S. Department of Agriculture

Forecasting World Cotton Prices,
Stephen MacDonald, Economic Research Service
U.S. Department of Agriculture

Forecasting Crop Prices Under New Farm Legislation

by
Peter A. Riley
Economic Research Service
U.S. Department of Agriculture

The tradition of strong government involvement in agriculture is starting to break down around the world. This tendency has been particularly evident in the United States over the last few years and especially since 1996, when the most recently enacted farm legislation sharply reduced government intervention and gave more weight to market forces. This has prompted a reevaluation of forecasts that have been heavily shaped by policy variables. This paper will set the stage for presentations on price forecasting for 3 major U.S. field crops.

USDA regularly forecasts a variety of annual supply and demand components for the major field crops, as well as farm prices. These are published monthly and are widely used by farmers, processors, and other market participants, as well as USDA policy makers. The price forecasts are particularly important as critical input for other calculations and forecasts, such as farm income and food prices.[1]

I will focus on three main points as an introduction to the specific forecasting models. The first concerns the relevance and importance of accurate forecasting of agricultural prices for the farm sector and the economy as a whole. Second, forecasting in the agricultural sector involves some special challenges not necessarily encountered in other sectors. Third, there is a brief overview of the broad changes in agricultural policies that have occurred in the last few years that have prompted a new look at our forecasting tools.

Importance of Agricultural Price Forecasts

The monetary amounts involved in crop prices may seem small at first glance. However, the huge quantities produced add up to very large sums. For example, U.S. corn production has averaged more than 8.9 billion bushels a year between 1994 and 1996. Thus just a one-cent change in the farm price of corn represents a change of $89 million for the economy, with farmers capturing that much more or less revenue while end users pay a corresponding amount more or reap the savings.

The actual magnitude of changes in farm prices is typically much larger (for reasons that will be discussed later). Using the same years as above (1994-96), the annual variation in season average farm price of corn has averaged nearly 59 cents per bushel, translating into huge sums at the national level--an average approaching $5.3 billion. Ironically, these last 3 years have been one of the most volatile periods in the history in the corn market. For the other 2 crops discussed today, wheat and cotton, both the absolute quantity of production and the variability are smaller.

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[1] USDA does not forecast the U.S. farm price of cotton because this is prohibited by law. Today's cotton presentation will examine a world cotton price.

Although the role of crop prices may seem obscure to some people outside of agriculture, they do have a very large impact on the general economy by several measures. The multiplier effects of changes in prices of corn, wheat, and cotton will be felt at various levels and have implications for inflation. Spending by farmers in rural communities and expenditures on capital goods such as tractors and other farm equipment and land expenditures, whether through purchases or leases, are prime examples.

Another dimension of the general importance of these commodity prices is their use as raw materials for other products. Among the cases reviewed today, wheat is probably the most appreciated by the general public when they consume bread, pasta, bagels, and other baked goods. Cotton is also easily recognized in its clothing and textile applications. Perhaps corn is the least obvious with most of its use as a feed for livestock and poultry and as an input for many food and industrial products. These include corn sweeteners used in the major soft drinks and a tremendous variety of processed foods.

Finally, the farm price has a important role in shaping our export competitiveness. The United States has a consistently strong positive trade balance in agriculture. Although the U.S. is the world's leading exporter of wheat, corn, and cotton, the marketplace for each commodity is highly competitive and our market shares are far from assured.

Special Challenges for Agricultural Price Forecasts

Agriculture has some special features that have an important bearing on forecasting under any policy regime. Foremost is the large variability in supply and prices, largely stemming from weather impacts. As mentioned earlier, there is considerable price volatility from year to year for most field crops, and similarly on a monthly, weekly, or even daily basis.

Weather plays an important role in determining the size of annually produced crops, and therefore is the major culprit underlying large production variability. Most field crop production is critically dependent on rainfall, with only small portions of the crops produced under irrigation. Droughts, high temperatures, excessive moisture, and other weather factors often harm yields and reduce output. Sometimes, conditions are excellent, pushing production beyond expectations. Swings in production also reflect changes in plantings so the total area devoted to a crop can vary from year to year. The driving force behind acreage changes are primarily economic as farmers anticipate net returns from competing crops. Weather can also play a role, generally in a negative sense, when, for example, it is too wet to plant a particular crop on time.

Demand for these crops is generally much steadier than supply, but demand changes can also add to the variability in prices. Domestic demand for wheat for food use is fairly inelastic, but a portion of the crop is fed to livestock and this portion is more variable. Domestic use of cotton has been relatively steady in recent years. Although cotton competes with manmade fibers, substitution in the short run is quite limited. Domestic corn use displays strong annual variability, in large part because of the changes in supply. Some corn demand can be characterized as inelastic, including industrial uses such as starch and sweeteners and food use in breakfast cereals. However, the largest category of corn is used as a livestock feed and this portion fluctuates greatly, reflecting changes in animal inventories, livestock cycles, competition with other feedstuffs, and large swings in the supply and price of corn.

International developments play an important role in agricultural markets and tend to increase price variability. Each of the crops discussed today is highly dependent on exports. Exports of corn have accounted for around 20-25 percent of total disappearance in recent years, cotton exports more than 40 percent, and wheat around 50 percent. These sectors are thus vulnerable to the export fluctuations which are common for most field crops. Many inter-related factors account for this, such as changes in import demand, the availability of exports from competing suppliers, policy factors such as export subsidies and import tariffs, and tastes and preferences.

Probably, everyone vaguely remembers the sporadic grain import binges of the Soviet Union during the 1970's and 1980's that added instability to world markets. This is the extreme case of variability in agricultural trade, but unexpected spurts or sharp drops in imports and exports by other countries on a smaller scale are not that uncommon, with corresponding effects on farm commodity prices.

Changes in the Policy Environment

There is a very strong tradition of heavy government intervention in U.S. agriculture that started in the early years of the 1930's Depression. At that time, the Government began to provide price supports to farmers and started programs to idle acres to avoid overproduction. Over the years, these basic elements were continued, with many variations and often complex formulas that were little understood by many people outside the farm economy.

During the mid-1980's, policy changes began to take effect to reduce the role of government and allow more market influence. This stemmed from a farm crisis partly triggered by a declining export market share as competitors undercut high U.S. prices. Thus, policies shifted somewhat, and U.S. price supports were reduced to enhance competitiveness. Another important step at the time was to start reducing large stocks of grain and other crops that had accumulated when the government offered an assured home for virtually all the major fields crops. By the early 1990's, like many other sectors of the economy, agriculture had reduced inventories. This reflected both budgetary pressures in the public sector reducing publicly held stocks and developments in the private sector adopting a "just in time" deliveries approach.

While still heavily shaped by government decisions, these and other changes initiated in 1985 farm legislation and continued by legislation in 1990 gradually were introducing more market forces to shape production decisions. Then in 1996, a more radical Farm Bill was enacted, signaling a more abrupt break with past tradition. Often called "Freedom to Farm," the new law essentially allowed farmers to make decisions completely free from government influence.

Nearly all government farm programs were eliminated, such as the acreage "setaside" or modern land idling program used when supplies were very large. Another important change was the end of the "base acres" concept under which farmers devoted a certain amount of land to a particular crop in order to qualify for farm program benefits. This tended to keep acreage at fairly predictable levels depending on various program parameters. Now, farmers have complete flexibility to plant what they want based entirely on market signals.

New Forecasting Approaches Contribute to USDA Market Analysis

The presentations to follow will look at forecasting models for 3 agricultural commodities and how analysts are dealing with the changing policy setting. Many of the broad similarities have been mentioned, and now some of the distinct traits of each market will be discussed. The corn and wheat papers focus on U.S. policy change, and the cotton paper deals with the interaction of policy variables in a global setting. The forecasting approaches can accurately be characterized as constantly evolving, as analysts incorporate more years of data and react to shifts in policies.

The context in which these forecasting models are used at USDA is important. First, these are applied tools that are used to help develop price forecasts that, except for cotton, are regularly published. USDA publishes a longer-term projection annually, while the forecast for the nearby year is published monthly. The latter price forecast is released at 8:30 AM on the day of the reports, along with various supply and demand elements. Thus, much of the analysis is conducted during the night, incorporating new information made available to USDA economists only shortly before being released to the public. The quick turnaround of this process requires highly practical tools. Second, the price is just one component of a broader analysis of supply, use, and stocks. These price models may be embedded in spreadsheets to provide a simultaneous determination of prices to changes in supply or demand forecasts. USDA presents this information in commodity "balance sheets" to provide a consistent analysis of each market.

FORECASTING ANNUAL FARM PRICES OF U.S. WHEAT IN A NEW POLICY ERA

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Introduction

Information regarding wheat prices is critical to market participants who are making decisions about managing price risk. Market information is also important to policymakers who have to assess the impacts of domestic or international events upon wheat farm prices.

Concern about U.S. wheat farm prices rose significantly during the 1995/96 crop year, as world crop shortfalls caused USDA's price projection for the crop year to rise from a range of \$3.25-\$3.65 per bushel in May 1995 to \$4.20-\$4.50 per bushel in November 1995. Two years later, as world production recovered, producers' wheat prices are expected to fall. USDA's price projection for 1997/98 dropped from a range of \$3.60-\$4.20 in May 1997 to \$3.05-\$3.65 in August 1997.

Price information has become even more important due, in part, to changes in U.S. agricultural policy. Passage of The Federal Agriculture Improvement and Reform Act of 1996 (1996 Act) continues the sector's trend toward market orientation. The Farmer-Owned Reserve (FOR) is suspended and wheat loan rates are capped at the 1995 level of \$2.58 per bushel, well below current and expected future market prices. Such a situation suggests little, if any, government stockholding, which may contribute to increased price sensitivity.

The 1996 Act also eliminated government price assurances. Under the 1996 Act, annual production flexibility contract payments remain fixed regardless of market prices, in contrast to deficiency payments which varied inversely to market prices. Consequently, producers face greater risk of income volatility because of market price variation.

Previous analyses have studied relationships between prices and ending stocks for corn (Baker and Menzie; Van Meir; Westcott, Hull, and Green), wheat (Westcott, Hull, and Green), and rice (Hoffman, Livezey, and Westcott; and Lin, Novick, and Livezey) as a price forecasting tool. Whether such a relationship can continue to provide short and long term price forecasts in the new policy environment remains to be seen.

The purpose of this article is to present a model designed to forecast the U.S. season average price of wheat at the farm level.[1] The U.S. Department of Agriculture analyzes agricultural commodity markets on a monthly basis and publishes annual current year market information, including price projections. Because of changes in policy, price forecasting equations need to be re-evaluated.

Background: Factors Affecting the U.S. Farm Price of Wheat

Some of the most important variables to be considered in forecasting the price of wheat include supply and demand factors and domestic agricultural policy (Appendix Tables 1, 2, and 3). Prices are determined by the interaction of the supply and demand functions which are influenced by government policies. The supply and demand components are briefly discussed because they affect the stocks and use variables which are included in the price equation.[2] Agricultural policies may also affect the factors of supply and demand. Many of these effects are captured in the stocks or use variables and those that are not will be accounted for separately in the price model.

Wheat Supply

The elements of supply are beginning stocks, imports, and production. Wheat is the principal food grain in the United States and throughout much of the world. The United States is the third largest producer of wheat in the world, averaging 61.6 million metric tons in 1994-96, or 11 percent of world production. U.S. wheat's farm value of production totaled \$9.8 billion in 1996, the fourth largest of all field crops or 11.4 percent of total U.S. crop value.

Beginning Stocks--Last year's carryover becomes the current year's beginning stocks. Large or small carryover levels usually have the most impact on price. Large stocks can provide a cushion in a short crop year or a low carryover may exacerbate a low production situation.

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[1] This price model is one of many price forecasting tools used by the USDA. Other price forecasts used by USDA are based on futures market prices and other econometric models. Analysts' expert opinions also enter into the forecasting process.

[2] Stocks are equal to ending carryover inventories and use refers to total use of a commodity, both total domestic and export use.

Imports--Wheat imports were an insignificant factor for U.S. supply for many years. Imports were fairly low in volume and less than 1 percent of supply between 1960 and 1989. However, wheat imports became an issue in the 1993/94 marketing year, as they reached 109 million bushels, including products, or 4 percent of supply. Imports have since declined to about 3 percent of supply, but the U.S. remains an attractive market for Canadian wheat.

Production--U.S. wheat production, the major component of supply, is determined jointly by the area harvested for grain and yield per acre. Until the 1996 Act, acreage planted and harvested was affected by farm program requirements and participation rates. The relationship between area planted and harvested varies substantially by region although it is fairly stable at the national level. Producers in cattle feeding areas typically graze out some of their wheat fields, rather than harvesting them for grain.

Prior to 1992, sharp declines or increases in planted area were usually the result of changes in government programs requiring acres to be idled. In an effort to control production, support farm income, and limit government costs, various acreage limitation programs were employed, such as the acreage reduction program, paid land diversion, 50/92, 0/92, and 0/85.[3] These supply management programs were eliminated in the 1996 Act. Thus, market prices rather than farm programs now have a greater influence on acreage planted to wheat.

Average U.S. wheat yields have risen from around 30 bushels per acre in the mid-1970's to an average of 38 bushels per acre in the 1990's. Wheat yield growth has slowed in the last 15 years. Many factors affect U.S. yields, including climatic conditions, weather, farm management practices, variety, and soil type.

Wheat Demand

Components of wheat demand are food use, feed and residual, seed, exports, and carryover stocks. Domestic use is a growing component of total U.S. wheat disappearance because of increased food use. Domestic use claims about 50 percent of total disappearance, up from an average 40 percent during 1975-84.

Food--Food use has been the largest and most stable component of domestic use, characterized by a steady growth rate. Wheat is unique because it is the only cereal grain with sufficient gluten to produce bread without requiring mixing with another grain. The domestic demand for wheat food use is relatively unaffected by changes in wheat prices and disposable income and is closely tied to population, tastes, and preferences.

Feed and Residual--Feed and residual use is more variable than food use and is related to corn/wheat prices and wheat crop quality. Wheat feed use is particularly prominent at wheat harvest time when wheat prices are low and new crop corn and sorghum have not been harvested. Feed and residual use totaled about 19 percent of total disappearance in the 1986 and 1990 crop years, years of lower wheat prices, compared to about 6 percent during 1988 and 1995, years of higher wheat prices. The residual component includes negligible quantities of wheat used for alcoholic beverages and estimation error from other categories.

Exports--Exports are important to the U.S. wheat market, as U.S. exports account for about half of total disappearance. Wheat exports accounted for 11.7 percent of the total value of U.S. agricultural exports or $7.0 billion in fiscal 1996. The United States is the world's largest exporter of wheat with a world market share of about 33 percent.

Food Aid under P.L.480, guaranteed export credit, and special export programs have been very helpful to U.S. wheat exports. The Export Enhancement Program (EEP)[4] was important to U.S. wheat exports between 1986 and 1994 as over half of the U.S. exports in some of these years received EEP subsidies (Fig. 1). EEP has not been used for U.S. wheat exports since July 1995. It is unclear whether EEP will be used in the future, but the 1996 Act authorizes its use at reduced levels.

Carryover Stocks--Carryover stocks reached levels greater than 1 billion bushels between 1981 and 1987, with ending stocks representing an average of 60 percent of one year's use. However, as policies steered the sector toward greater market orientation, ending stocks declined and a more balanced supply and use situation arose in 1991-96 with an average stocks-to-use ratio of 21 percent.

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[3] If supplies were estimated to be in excess by the U.S. Department of Agriculture, acreage reduction programs (ARPs) were required and paid land diversion programs (PLDs) were permitted. Wheat producers had the option of under-planting their maximum payment acres and receiving deficiency payments on a portion of the under-planted acres (0,50/85-92).

[4] The Export Enhancement Program was initiated in May 1985 under the Commodity Credit Corporation (CCC) Charter Act and later formally authorized by the Food Security Act of 1985 and extended by the Food Agriculture Conservation and Trade Act of 1990 and the 1996 Act. The major objective of this program is to help U.S. exporters compete against unfair trade practices used by other countries. Export bonuses were used to make U.S. agricultural commodities competitive in world markets. Exporters received generic certificates prior to November 1991 and cash bonuses thereafter.

Agricultural Policies

Domestic agricultural policies may also affect the factors of supply and demand. Many of these effects are captured in the stocks or use variables. For example, Government price support programs have affected levels of carryover stocks over time. Between the 1973 and 1996 farm bills, the loan program,[5] farmer-owned reserve, food security reserve and production controls have been used to support prices. Also, various export programs may enhance consumption of wheat by subsidizing the price of wheat. How these programs affected the price and stocks-to-use relationship is important for modeling wheat prices. Situations where policies altered the market price and stocks-to-use relationship must be specifically accounted for in the price equation. Consequently, a review of agricultural policies is necessary to determine when adjustments to the price and stocks-to-use relationship occurred.

The Agriculture and Consumer Protection Act of 1973 changed the existing income programs by replacing the wheat certificate program with the target price concept (Harwood and Young). Carryover stocks consisted only of free stocks in 1974-76 and the stocks-to-use ratio ranged from 26 to 65 percent for those years. Because grains and oilseeds generally had favorable prices during 1974-76 there was an effort to make farm programs more market oriented. The target price accompanied with deficiency payments was designed to support income without affecting market price. However, strong prices in 1974-76 led to increased production and larger stocks (Appendix Tables 1 and 2).

The Food and Agriculture Act of 1977 established the farmer-owned grain reserve (FOR), which was in response to the growing importance of exports and the potential for greater global demand and price instability. In return for loans and annual storage payments, farmers agreed not to market their grain for an extended period (3 to 5 years), unless the average farm price reached a specified level called the release price. The farmer-owned reserve allowed the producer to maintain ownership of the grain in contrast to a situation where a producer would forfeit stocks to the government at low prices under the regular loan program with no opportunity to realize a gain if prices rose.

Entry into the wheat FOR, the FOR loan rate, and the regular wheat loan rate appeared to heavily support annual farm prices during the late seventies to mid-eighties (Figs. 2, 3, and 4). Prices approached the loan rate in 1977, the year when the Farmer-Owned Reserve was introduced. Minimum loan rates were written into The Agriculture and Food Act of 1981. The regular loan rate for wheat was $3 a bushel in 1980 and reached $3.65 in 1983. Defaults to the CCC began to rise and CCC stock levels surged. Loan rates were reduced to $3.30 in 1984 and 1985. During the mid-1980s, market prices were pressured downward when accumulated CCC stocks were released upon the market. In retrospect, loan rates in the early 1980's were set so high that they supported prices above market clearing levels.

During 1980-82, the FOR was implemented as a price enhancement tool by offering producers reserve loans at rates above the regular loan rate. This situation raised questions about the FOR's goals, price stability or price enhancement. The FOR loan rate was set at $4.00 per bushel in 1982/83, $0.45 above the regular loan rate. Harvested acres were the second highest ever in 1982/83 and this contributed to a rise in ending stocks to 1.52 billion bushels of which over 1 billion bushels were in the FOR (Fig. 3).

The Food Security Wheat Reserve was created in the 1980/81 marketing year to provide a government-held reserve of up to 4 million metric tons of wheat for emergency food needs in developing countries. This reserve was also part of the Government's response to criticism for the Russian grain embargo. In general this reserve has not been a factor in the wheat market during the 1990's, although some wheat was released during the 1995/96 marketing year. The authority for the Food Security Wheat Reserve was repealed with the 1996 Act and a new Food Security Commodity Reserve was established that includes wheat, corn, grain sorghum, and rice.

Because of large stock buildups, the Food Security Act (FSA) of 1985 was designed to increase U.S. competitiveness in world markets and to support farm income (Hoffman, Schwartz, and Chomo). The FSA moved agriculture toward a more market-oriented farm policy that would enable farmers to respond to economic and market signals. The legislation lowered loan rates and provided discretionary authority for their adjustment, modified the FOR to prevent large buildups in stocks, reversed upward trends in target prices, generally froze program yields, and authorized EEP and initiated the Targeted Export Assistance Program (TEAP) to promote agricultural exports in response to subsidized competition. The Conservation Reserve Program was implemented with a goal of retiring 40-45 million acres of highly erodible cropland from production for a period of 10-15 years.[6]

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[5] Price support for wheat producers is provided through nonrecourse loans at the announced price support loan rate. A participating farmer can pledge his crop as collateral to the Commodity Credit Corporation (CCC) and then receive a 9-month loan pledged at a predetermined rate per bushel. If the market price is above the loan rate plus interest, the producer usually repays the loan with interest. However, if the market price is below the loan rate plus interest, the producer may forfeit the wheat at the end of the loan term to the Commodity Credit Corporation in full satisfaction of the loan.

In 1986 stocks had been equal to 83 percent of total use but declined to 16 percent in 1995 (Fig. 4). Generic certificates[7] helped reduce the level of government and FOR stocks.

The Food, Agriculture, Conservation, and Trade Act of 1990 as well as the subsequent Omnibus Budget Reconciliation Act of 1990 (OBRA), followed the ground work laid by the FSA of 1985. The main goals of the FACT Act of 1990 were to further reduce spending, to help maintain farm income growth through expanding exports, and to enhance the environment. Major mechanisms used to accomplish reduced budget expenditures and improved agricultural competitiveness were reduced payment acres (as authorized by the Omnibus Budget Reconciliation Act) and planting flexibility. The Conservation Reserve Program of the 1985 FSA was altered to cover lands adversely affecting water quality and wetlands, and a new Water Quality Protection Program was added.

The Food, Agriculture, Conservation, and Trade (FACT) Act of 1990 continued keeping commodity loan rates low and reducing the role of the Farmer-Owned Reserve, thereby phasing out government-owned stocks as a stabilizing device. Wheat FOR activity declined under the 1990 Farm Bill and ceased during the 1993/94 marketing year. Annual acreage reduction programs helped maintain stabilization. The stocks-to-use and price relationship seems to have changed for the years of 1990 through 1994. Some of the factors that may have caused this change include a change in EEP program administration where subsidies were switched from generic certificates to cash; passage of trade agreements, the Canada-U.S. Free Trade Agreement and the North American Free Trade Agreement, allowing for increased trade between Canada and the U.S.; and a general policy change that minimizes government stocks.

The 1996 Act continues the trends of the previous two major farm acts toward greater market orientation, thereby gradually reducing the Government's commodity program influence in the agricultural sector (Young and Westcott). Annual production flexibility contract payments replace the deficiency payment income support mechanism. Price support programs are continued but loan rates are kept at minimal levels, the FOR is suspended, annual supply control programs are eliminated, and planting decisions are decoupled from program parameters.

The 1996 Act continues the marketing loan provisions for wheat but since the wheat loan rate is capped at the 1995 level of $2.58 per bushel, significant activity under these provisions is unlikely. Marketing loan provisions for wheat began with the 1993 crop year. This program has had little effect on wheat prices because prices have generally been above the loan rate[8].

Analytical Framework

This section illustrates how stocks are related to supply and demand within a general equilibrium model and develops the statistical model.

A general equilibrium model is illustrated which reflects competitive behavior (Labys; Westcott). The model features supply, demand, stocks, and a market-clearing identity.

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[6] A program where producers sign contracts to convert environmentally sensitive cropland to approved conservation uses for a 10 to 15 year period, in exchange for rental payments and payments to share costs of establishing conservation practices. The CRP program is available to participants and non-participants in the annual farm programs. The producer submits a bid for a 10 or 15 year contract stating the annual payment they would accept to convert this land to a conserving use. If the bid is accepted, USDA pays an annual rent to keep this land in a conservation use. There were about 9 million acres of wheat base acres voluntarily enrolled in the CRP in 1997. Obviously, such a program reduces wheat's production potential.

[7] Negotiable certificates, which do not specify a certain commodity, issued by USDA in lieu of cash payments to commodity program participants and sellers of agricultural products. The certificates can be used to acquire stocks held as collateral on Government loans or owned by the Commodity Credit Corporation. Farmers have received generic certificates as payment for participation in numerous Government programs. Grain merchants and commodity groups also have been issued certificates through the Export Enhancement Program and the Targeted Export Assistance Program.

[8] In 1993, some loan deficiency payments (LDPs) were made to wheat farmers. Most payments were for soft red winter wheat located in certain Texas counties. Total wheat LDPs paid to farmers were less than $1 million.

$S = f_1(p, z, flp)$

$D = f_2(p, y, z)$

$I = f_3(p, z, flp, D9094)$[9]

$S - D - I = 0$

where endogenous variables are: S = supply, D = demand, I = ending stocks, and p = market prices. Exogenous variables are flp = FOR and loan program, y = disposable income, D9094 = a period of an apparent shift in the pricing relationships, and z = other exogenous variables.

With the system in equilibrium, prices can be determined from the inverse of the stocks function. At that price, the supply and demand levels give an ending stocks estimate which is consistent with the equilibrium price, through the price-ending stocks relationship.

In the inverse stocks function-price determination equation, prices are negatively related to stocks. Ending stocks of an annual storable commodity, such as wheat, reflect the relationship between supply and use (Labys). If total use rises relative to supply, farm prices tend to rise as ending stocks decline. On the other hand, if supply rises relative to total use, prices tend to decline as ending stocks accumulate.

$p = f_3^{-1}(I/D, flp, D9094)$

The stocks variable is transformed to reflect stocks relative to total consumption (Westcott). Therefore, the stocks variable (I) is expressed as a percent of total use (I/D). This has particular importance over time as demand for carryover stocks may increase because of growth in the size of the wheat sector, measured here by total demand.

Prices are expected to be positively related to the loan rate, especially in those years that loan rates were set high relative to market prices and the loan program and farmer-owned reserve isolated stocks from the marketplace. Price support and stabilization measures tend to increase the price received by producers usually through government purchases. Entry into the wheat FOR, FOR loan rates, and regular loan rates tended to limit price reductions especially during 1979-85 (Fig. 1, Appendix Table 2, and Fig. 2). Many grain price models have been estimated with the dependent variable of price minus loan rate. This relationship was used in past unpublished wheat price forecasting equations, by Baker and Menzie's annual corn price model, and by Van Meir's analysis of corn prices and stocks. Such a dependent variable is no longer valid in today's market as market prices are well above support prices.

Although there was a return to market orientation during 1986-96, some of the different relationships found from 1990 through 1994 could be due to a number of factors (Fig. 4). First, EEP program administration may account for some of this change because program subsidies switched from generic certificates to cash in November 1991. Second, passage of trade agreements, CFTA and NAFTA, allows for increased trade between Canada and the U.S. Third, general policy level changes minimize government stocks. Additional research is required to explain these relationships.

Model Specification

The price-carryout stocks relationship, equation (1), specifies annual producer price as a function of the stocks-to-use ratio, loan rates for the period 1979 through 1985, and a dummy variable to capture a shift in the pricing relationships during 1990 through 1994. Based on the relationships observed in figure 4, it appears that a logarithmic functional form would best fit the data between 1975 through 1996. A double log function is specified and estimated with ordinary least squares (OLS) regression to explain the all-wheat price with 22 observations.

$$\text{(1)} \quad \mathrm{Log}(P) = a + b\,\mathrm{Log}(I/D) + c\,\mathrm{Log}(FLP)*(D7985) + d\,(D9094)$$

Where:

P = Weighted season average farm price for all wheat.[10]
a = intercept term. It is hypothesized that this coefficient

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[9] Additional determinants of stock demand include differences between current and expected futures prices and interest rates.

[10] This price is computed by the USDA's National Agricultural Statistics Service. A monthly survey is conducted to determine the price producers receive. These prices are weighted by the monthly percent of marketings for the total marketing year. In the process each of the five wheat classes are taken into account to arrive at an all wheat price.

is positive. If the logarithm of the stocks-to-use ratio is zero, price is expected to be a positive number.

b = Estimated coefficient for the stocks-to-use variable. It is hypothesized that this coefficient is negative. As the stocks-to-use ratio declines, reduced stocks cause increased upward pressure on the farm price. The demand for carryout stocks is less at higher prices.

I = Ending stocks, i.e. total carryover inventories.

D = Total domestic and export disappearance.

c = Estimated coefficient for the FOR and loan program variable, representing years, 1979 through 1985, when the FOR and loan programs kept market prices artificially high. The sign of this coefficient is expected to be positive.

Log(FLP)*(D7985) = An intercept shifter for the years 1979 through 1985, a time when prices were heavily supported by the FOR and loan programs. FLP = Regular loan rate and D7985 = 1 in 1979 through 1985 and zero for other years.

d = Estimated coefficient for a dummy variable that represents an apparent shift in the pricing relationship for the years of 1990 through 1994.

D9094 = A dummy variable equal to 1 for 1990 through 1994 and zero for other years. This variable is an intercept shifter, in contrast to a slope shifter.

Data

Data for the estimation of equation (1) are found in Wheat: Situation and Outlook Yearbook. Data are shown in Appendix Tables 1, 2, and 3.

Results

The estimated price equation is shown in Table 1. The coefficients for the intercept and loan rates are positive and the coefficient for the stocks-to-use variable is negative, all as hypothesized. The coefficient for the 1990-94 dummy variable was negative. The estimated price equation has significant t-statistics and 88 percent of the variation (log of annual wheat prices) is explained by the equation. The t-statistics are shown in parentheses below each estimated coefficient. All estimated coefficients are significant at the 1-percent level. Price forecasts based on equation (2) and a range of corresponding stocks-to-use ratios are shown in Figure 5.

Table 1: Ordinary Least Squares Estimates for the Wheat Price Equation, 1975-96

$$(2)\ \text{Log}(P) = \underset{(19.73)}{2.6225} - \underset{(-11.08)}{0.40263}\ \text{Log}(I/D) + \underset{(7.116)}{0.21941}\ \text{Log}(FLP)*D7985$$

$$\underset{(-5.522)}{-0.2217}\ (D9094)$$

$R^2 = 0.883$

Standard error of the estimate = 0.066807

Durbin-Watson statistic = 2.2679

Degrees of freedom = 18

Note: Autocorrelation adjustments were not necessary.

Price Forecasts

The annual 1997/98 price forecast for all wheat at the producer level is \$3.54 per bushel, based on results found in equation (3).

$$(3)\ \dot{P} = e^{(2.6225 - 0.40263*Log(I/D) + 0.21941*Log(FLP)*D7985 - 0.2217*D9094)}$$

This price forecast falls within the upper end of the price projection range of \$3.05 to \$3.65 per bushel released in the World Agricultural Supply and Demand Estimates (WASDE) report, August 12, 1997. Based on the August 1997 WASDE report, the projected 1997/98 stocks-to-use ratio was 29.3 percent. Inserting this ratio into equation (3) yields a price projection of \$3.54 per bushel. With the standard error of the estimate equal to 0.0668 there is a two-thirds chance that the price will fall within a range of \$3.31 to \$3.78 per bushel.

Price forecasts and ranges corresponding to different stocks-to-use ratios are shown in Table 2.

Table 2: Season Average Price Forecasts for All Wheat, Assuming Different Stocks-to-use Ratios

Stocks-to-use Ratio	Price Projection	Price Range ± 1 Standard error of Estimate
Percent	------ Dollars per Bushel ------	
5.0	7.20	6.74--7.70
7.5	6.12	5.72--6.54
10.0	5.45	5.10--5.83
12.5	4.98	4.66--5.32
15.0	4.63	4.32--4.95
17.5	4.35	4.07--4.65
20.0	4.12	3.86--4.41
22.5	3.93	3.68--4.20
25.0	3.77	3.52--4.02
27.5	3.63	3.39--3.88
30.0	3.50	3.27--3.74
32.5	3.39	3.17--3.62

Model Performance

The performance of the wheat price equation was deemed satisfactory (Fig 6).[11] Although it captured only 6 of the 8 turning points in the period 1975-96, the mean absolute error for the period was $0.150 per bushel or a mean absolute percentage error of 4.8 percent. The mean absolute error ranged from $0.006/bushel in 1990 to $0.329/bushel in 1977. In comparison, the mean absolute percentage error for corn price forecasts during the period 1975-96 for a similar model was $0.12 per bushel and the mean absolute percentage error was 5 percent (Westcott 1997).

Conclusions

The wheat price forecasting model presented a stocks-to-use ratio to explain the annual farm price of wheat. A double log price equation was estimated which related the stocks-to-use ratio of wheat to the annual producer price. In-sample performance of this model was deemed satisfactory with 88 percent of the price variation explained. Although the wheat price equation had strong statistical properties, further efforts are needed to explain the relationships during the period of 1990 through 1994. This time period may have been affected partly affected by interactions with the global wheat marketplace and by the U.S. EEP program, factors not explicitly represented by the model.

This price model should be used with care. The model may omit other factors that can influence price. However, it is argued that the effects of these variables are largely captured in the stocks and use variables. The main variables included in this model, stocks and use, may be related to each other in ways that suggest use of estimation techniques more sophisticated than regression analysis. Nevertheless, this model provides a strong analytical tool in the arena of price forecasting. It is simple and easy to use and has reasonable forecasting accuracy.

Suggestions for Further Research

Several additional approaches seem warranted with the stocks-to-use model.

- The relationship between nominal wheat prices and inflation should be examined.
- The relationship between free stocks and prices should be examined, thereby removing the stocks that were isolated from the marketplace by Government programs. Also, what relationship exits between Government stocks/total stocks and prices?
- The effects of EEP, imports, and other global market interactions should be explored. What effects has EEP had on the U.S. producer price for wheat? How have these effects affected the level of imports? Also, have imports affected the U.S. producer price for wheat?
- The different effects of food, feed, and export demand should be explored, to represent valuations of wheat quality factors implicit in different uses.

Lastly, is a stocks-to-use model, simultaneous set of equations model, or simulation model adequate to forecast prices in the new policy era? Each model type relies upon past observations influenced by past policies and events. In the past 22 years the wheat sector has been free of government and FOR stocks for only 3 years, 1974-76. Are there other approaches that would be more appropriate?

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[11] Performance was based on in-sample statistics. Insufficient observations preclude out of sample statistics.

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Appendix Table 1: U.S. Wheat Supply and Disappearnance by Marketing Year, 1974/75-1997-98 1/

Year beginning June1	Supply				Disappearance						Ending Stocks May 31		
					Domestic Use								
	Beginning Stocks	Prodcution	Imports 2/	Total	Food	Seed	Feed 3/	Total	Exports 2/	Total Disap-pearance	Government owned	Privately owned 4/	Total
							Million bushels						
1974/75	340.1	1,781.9	3.4	2,125.4	545.0	92.0	34.9	671.9	1,018.5	1,690.4	NA	435.0	435.0
1975/76	435.0	2,126.9	2.4	2,564.3	588.5	100.0	37.3	725.8	1,172.9	1,898.7	NA	665.6	665.6
1976/77	665.6	2,148.8	2.7	2,817.1	588.0	92.0	74.4	754.4	949.5	1,703.9	NA	1,113.2	1,113.2
1977/78	1,113.2	2,045.5	1.9	3,160.6	586.5	80.0	192.5	859.0	1,123.8	1,982.8	43.3	1,129.5	1,177.8
1978/79	1,177.8	1,775.5	1.9	2,955.2	592.4	87.0	157.5	836.9	1,194.2	2,031.1	51.1	873.0	924.1
1979/80	924.1	2,134.1	2.1	3,060.3	596.1	101.0	85.9	783.0	1,375.3	2,158.3	187.8	714.2	902.0
1980/81	902.0	2,380.9	2.5	3,285.4	610.5	113.0	59.0	782.5	1,513.8	2,296.3	199.7	789.4	989.1
1981/82	989.1	2,785.4	2.8	3,777.3	602.4	110.0	134.8	847.2	1,770.7	2,617.9	190.3	969.1	1,159.4
1982/83	1,159.4	2,765.0	7.6	3,932.0	616.4	97.0	194.8	908.2	1,508.7	2,416.9	192.0	1,323.1	1,515.1
1983/84	1,515.1	2,419.8	3.8	3,938.8	642.6	100.0	371.2	1,113.8	1,426.4	2,504.2	188.0	1,210.6	1,398.6
1984/85	1,398.6	2,594.8	9.4	4,002.8	651.0	98.0	407.1	1,156.1	1,421.4	2,577.6	377.6	1,047.6	1,425.2
1985/86	1,425.2	2,424.1	16.3	3,865.6	674.3	93.0	284.2	1,051.5	909.1	1,960.7	601.7	1,303.3	1,905.0
1986/87	1,905.0	2,090.6	21.3	4,016.8	712.2	84.0	401.2	1,197.4	998.5	2,195.9	830.1	990.8	1,820.9
1987/88	1,820.9	2,107.7	16.1	3,944.7	720.7	85.0	290.2	1,096.0	1,587.9	2,683.8	283.0	977.8	1,260.8
1988/89	1,260.8	1,812.2	22.7	3,095.7	725.8	103.0	150.5	979.2	1,414.9	2,394.1	190.5	511.1	701.6
1989/90	701.6	2,036.6	22.5	2,760.7	748.9	104.3	139.1	992.3	1,232.0	2,224.3	116.6	419.9	536.5
1990/91	536.5	2,729.8	36.4	3,302.6	789.8	92.9	482.4	1,365.1	1,069.5	2,434.5	162.7	705.4	868.1
1991/92	868.1	1,980.1	40.7	2,889.0	789.5	97.7	244.5	1,131.6	1,282.3	2,413.9	152.0	323.0	475.0
1992/93	475.0	2,466.8	70.0	3,011.8	834.8	99.1	193.6	1,127.6	1,353.6	2,481.2	150.0	380.7	530.7
1993/94	530.7	2,396.4	108.8	3,035.9	871.7	96.3	271.7	1,239.7	1,227.8	2,467.4	150.3	418.2	568.5
1994/95	568.5	2,321.0	91.9	2,981.4	853.0	89.2	344.4	1,286.6	1,188.3	2,474.8	142.1	364.5	506.6
1995/96	506.6	2,182.6	67.9	2,757.1	883.0	104.1	151.9	1,140.0	1,241.1	2,381.1	118.2	257.8	376.0
1996/97	376.0	2,281.8	90.0	2,747.8	892.0	103.0	310.0	1,305.0	1,001.0	2,306.0	93.0	351.2	444.2
1997/98 5/	444.2	2,530.5	95.0	3,069.7	900.0	100.0	275.0	1,275.0	1,100.0	2,375.0	93.0	601.7	694.7

NA=Not available

1/Totals might not add because of rounding.

2/Imports and exports include flour and other products expressed in wheat equivalent.

3/Residual; approximates feed use and includes negligible quantities used for distilled spirits.

4/Includes outstanding and reserve loans.

5/projected as of August 12, 1997.

Source: Wheat: Situation and Outlook Yearbook. U.S. Department of Agriculture, Economic Research Service. WHS-1997. March 1997.

Appendix table 2: Wheat: Carryover Stocks, Farm Prices, and Support Prices 1974/75-1997/98

Crop year	Carryover Stocks				Price received	Loan rate	Target price	Direct payment
	CCC	FOR 1/	Free	Total 2/				
	Million bushels				$/bushel			
1974/75	---	---	435	435	4.09	1.37	2.05	---
1975/76	---	---	666	666	3.56	1.37	2.05	---
1976/77	---	---	1,113	1,113	2.73	2.25	2.29	---
1977/78	48	342	788	1,178	2.33	2.25	2.90	0.65
1978/79	51	393	481	924	2.97	2.35	3.40	0.52
1979/80	188	260	454	902	3.80	2.50	3.40	---
1980/81 *	200	360	429	989	3.99	3.00	3/3.63	---
1981/82 *	190	562	407	1,159	3.69	3.20	3.81	4/ 0.15
1982/83 *	192	1,061	262	1,515	3.45	3.55	4.05	0.50
1983/84 *	188	611	600	1,399	3.51	3.65	4.30	0.65
1984/85 *	378	5/ 654	393	1,425	3.39	3.30	4.38	1.00
1985/86 *	602	5/ 433	870	1,905	3.08	3.30	4.38	1.08
1986/87 *	830	5/ 463	528	1,821	2.42	2.40	4.38	1.98
1987/88 *	283	467	511	1,261	2.57	2.28	4.38	1.81
1988/89 *	190	287	225	702	3.72	2.21	4.23	0.69
1989/90 *	117	144	275	536	3.72	2.06	4.10	0.32
1990/91 *	163	14	691	868	2.61	1.95	4.00	1.28
1991/92 *	152	50	273	475	3.00	2.04	4.00	6/1.35
1992/93 *	150	28	353	531	3.24	2.21	4.00	0.81
1993/94 *	150	6	412	568	3.26	2.45	4.00	1.03
1994/95 *	142	0	365	507	3.45	2.58	4.00	0.61
1995/96 *	118	0	258	376	4.55	2.58	4.00	0
1996/97 *	95	0	349	444	4.35	2.58	N.A.	0.87
1997/98 * 7/	93	0	602	695	3.35	2.58	N.A.	0.63

--- = Not applicable.
N.A. = Not available.
* = Includes food security resrve. 1/ Farmer-owned reserve. 2/Totals might not add because of rounding
3/Growers who planted in excess of their normal crop acreage were eligible for a target price of $3.08 a bushels.
4/ Deficiency payment rate, 1981/82 to 1995/96; production flexibility contract payment rate, thereafter.
5/ Includes special producer storage loan program. 6/Winter wheat option 1.25. 7/Projected as of August 12, 1997.

Source: Wheat: Situation and Outlook Yearbook. U.S. Department of Agriculture. Economic Research Service. WHS-1997. March 1997.

Appendix Table 3: U.S. Wheat Exports by Selected Programs

Fiscal Year	P.L.480	Section 416	Food for Progress	Aid 1/	Total concessional	CCC export credit	Export enhancement program	Total U.S. wheat exports	Total concessional, CCCexport credit, and EEP exports divided by total exports 2/
	1,000 Metric Tons								Percent
1978/79	3,234	0	--	7	3,241	2,684	0	31,340	19
1979/80	2,785	0	--	44	2,829	1,945	0	36,066	13
1980/81	2,537	0	--	4	2,541	3,261	0	42,246	14
1981/82	2,978	0	--	0	2,978	3,725	0	44,607	15
1982/83	3,340	0	--	123	3,463	8,597	0	36,701	33
1983/84	3,442	0	--	0	3,442	11,406	0	41,699	36
1984/85	4,392	0	--	74	4,466	8,221	0	28,524	44
1985/86	4,685	76	--	513	5,274	7,740	4,916	24,626	59
1986/87	3,927	406	--	1	4,334	8,125	12,214	28,204	67
1987/88	3,321	1,186	--	292	4,799	9,273	26,679	40,523	80
1988/89	3,020	137	--	806	3,963	8,897	17,906	37,660	68
1989/90	2,985	0	52	28	3,065	7,759	12,806	28,064	70
1990/91	3,067	0	92	0	3,159	8,339	15,150	26,792	78
1991/92	2,286	0	130	0	2,416	12,334	21,111	34322	76
1992/93 3/	2,043	890	1,067	NA	4,001	8,538	21,806	36081	79
1993/94 3/	2,801	0	726	NA	3,527	5,874	18,157	31145	75
1994/95 3/	1,491	0	457	NA	1,948	4,202	18,073	32088	68

1/U.S. Agency for International development Commodity Import Program. 2/Shares of wheat exports take into consideration the overlap between sales under the EEP and export credit guarantee programs. 3/Preliminary. --=Not applicable. NA = Not available.

Sources: P.L.480 shipment data are developed by USDA, ERS as of 2/19/97; export credit guarantee and EEP data are from USDA, FAS, Export Credits Divisions; export data are from USDA, ERS, Foregin Agricultural Trade of the United States.

Figure 1: U.S. Wheat Exports by Selected Programs and Total U.S. Wheat Exports, Fiscal Years 1978/79–1994/95

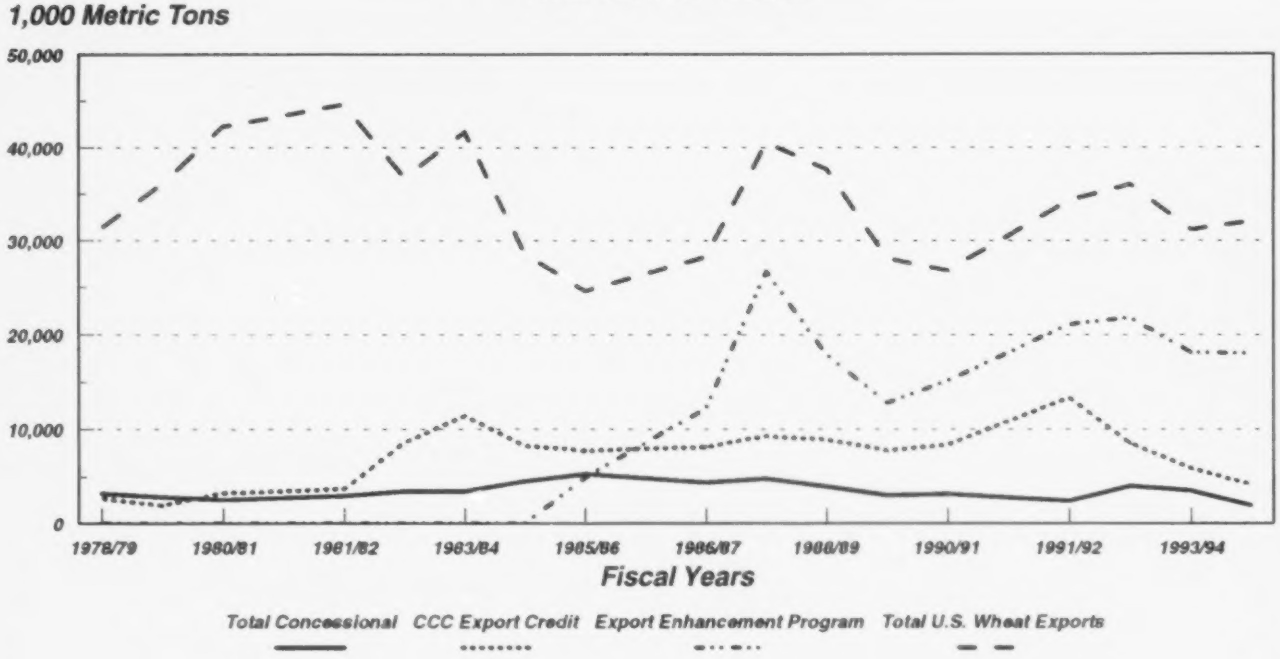


Figure 2: U.S. Wheat Farm Price and Loan Rate, Crop Years 1974-96

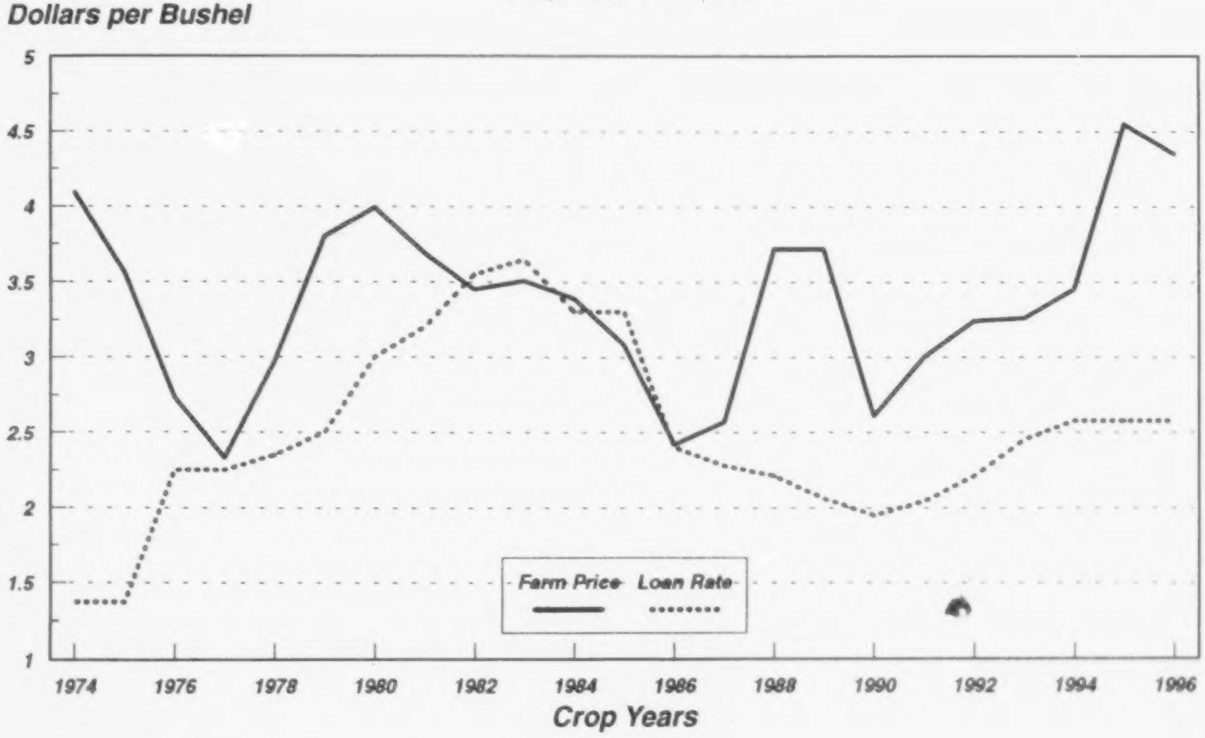


Figure 3: Ending Stocks of U.S. Wheat

Crop Years 1974-96

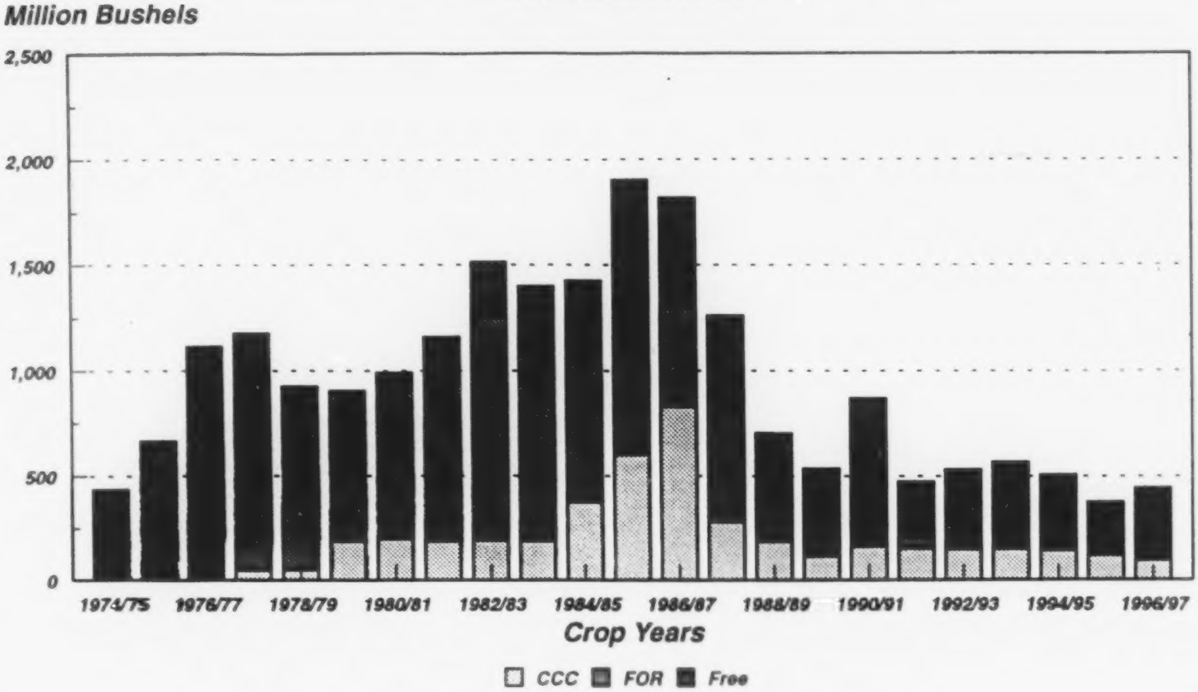


Figure 4: Annual Farm Price and Stocks-to-Use

Relationships, Crop Years 1975-96.

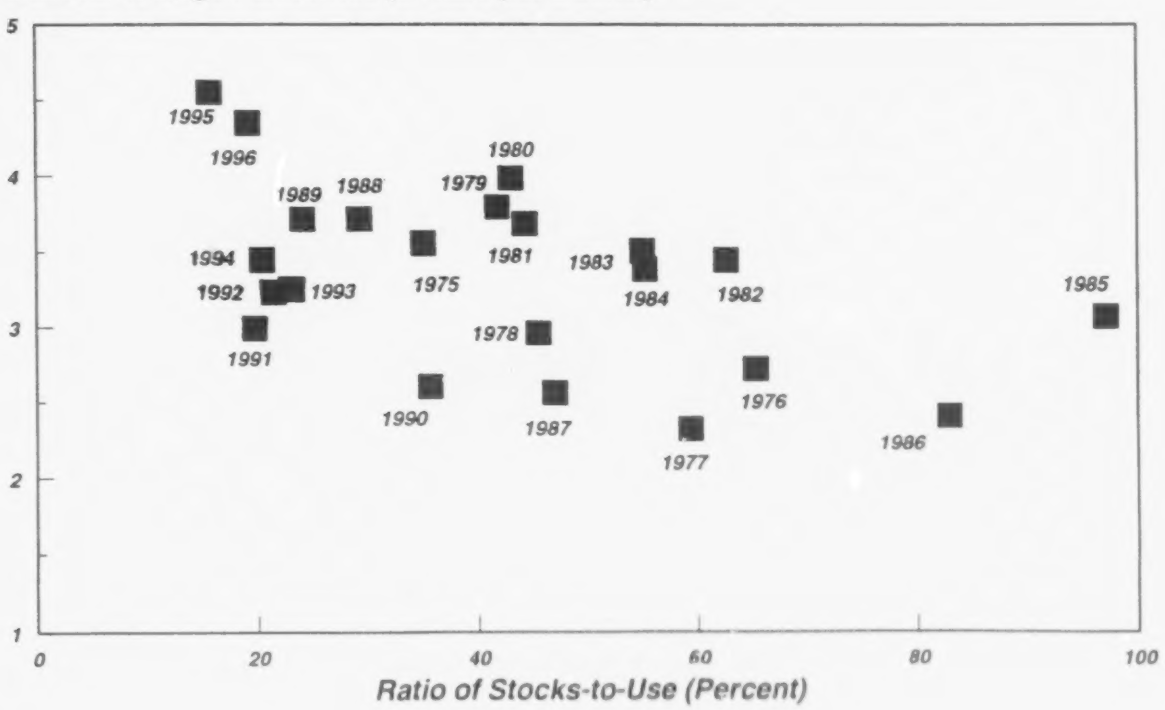


Figure 5: Forecasts of All Wheat Producer Price

Crop Years, 1975-96

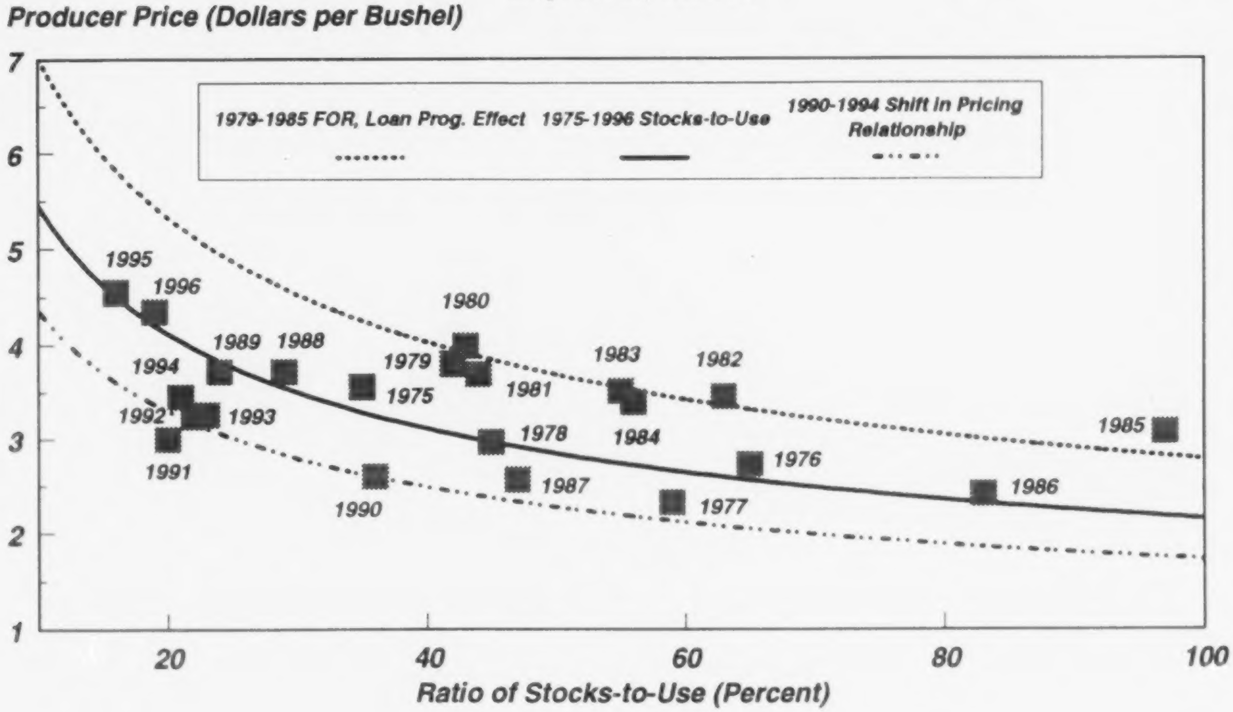
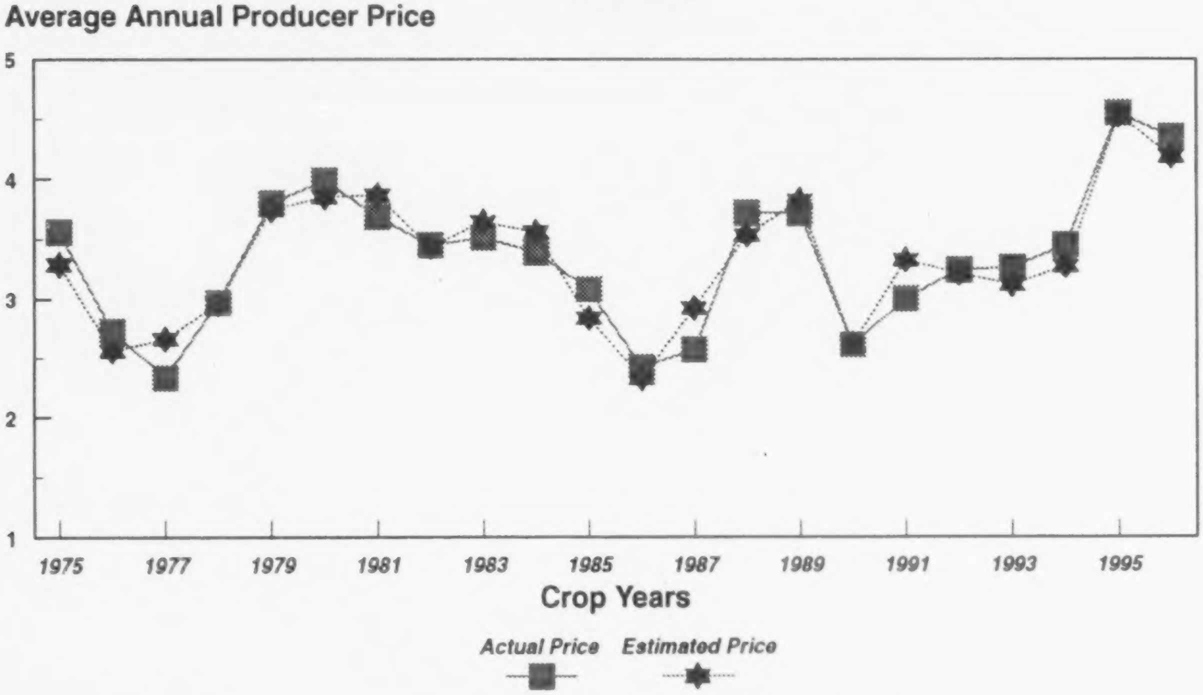


Figure 6: Comparison of Actual and Estimated Annual Producer Prices for Wheat, Crop Years 1975-96



AN ANNUAL MODEL FOR FORECASTING CORN PRICES

Paul C. Westcott, Economic Research Service, USDA

The U.S. corn crop plays a major role in the agricultural sector. As a source of income to farmers, corn is the largest crop in terms of cash receipts. Over the last 5 years, corn cash receipts have averaged more than $16 billion, accounting for about 17 percent of total crop cash receipts. Corn also has an important role in linkages within the agricultural sector among various crops and between crops and livestock. Corn competes with other crops for land in farmers' production decisions, particularly soybeans. Corn is also the largest feed grain used by the livestock sector. Further, the U.S. is the largest exporter of corn, accounting for over 70 percent of global corn trade thus far in the 1990s. Consequently, events which affect the corn sector and corn prices are carefully watched by many subsectors within agriculture.

New agricultural legislation enacted in 1996 fundamentally changed the nature of farm commodity programs in the United States, furthering trends towards market orientation in the sector. In particular, changes in the income support program shifted much of the risk of price volatility from the Government to producers (see Young and Westcott). As a result, market information affecting corn prices is particularly important under the 1996 Farm Act as farmers seek to make informed farm management decisions to manage risk and other market participants work within a more market-oriented agricultural sector.

To provide market information regarding the agricultural sector, each month the U.S. Department of Agriculture (USDA) analyzes major agricultural commodity markets and publishes annual supply, demand, and price projections for the current year. Additionally, once a year USDA publishes longer-term, 10-year projections for the agricultural sector that include commodity supply, demand, and prices.

This paper examines some of the factors that affect farm-level corn prices. An annual framework is employed to develop a corn price model, designed to be used in USDA's projection activities in conjunction with ongoing commodity market analysis of supply and demand factors. The relationship estimated builds on 2 types of factors that influence prices--market supply and demand conditions, and Government price support programs.

Market forces, as measured by supply and demand, influence prices. Year-ending stocks of an annually produced commodity, such as corn, summarize the effects of both supply and demand factors during the year, and are a useful indicator of price movements for the commodity. Annual prices for grains tend to have a strong negative correlation with their ending stocks. High stocks typically result in lower prices, while low stocks put upward pressure on prices.

Government programs have also been important in influencing farm-level prices for grains. Some programs have influenced prices indirectly by placing restrictions on the use of land for agricultural production, for example. Historically, the nonrecourse commodity loan program has directly affected prices by providing support to farm-level prices and affecting market equilibrium in some periods. The key policy variable used in the price modeling effort in this paper is the price support loan rate. However, the role of the loan rate in influencing prices has differed historically as the nature of the commodity loan program has changed under different farm legislation.

Previous Research

Many corn price models have employed the stocks-to-use ratio to represent market conditions in explaining movements in corn prices. The stocks-to-use ratio is defined as stocks of the commodity at the end of a particular time period divided by use of the commodity during that time period. As such, market conditions of supply and demand are summarized in this measure. Van Meir, and Baker and Menzie used stocks-to-use ratios in annual frameworks analyzing corn prices, while Westcott, Hull, and Green used such an approach in a quarterly model for corn prices. Numerous other unpublished annual corn price models using stocks-to-use ratios have been used internally within USDA in its forecasting activities. In each model, the stocks-to-use variable is negatively related to corn prices and provides a downward sloping nonlinear curve of prices plotted against ending stocks-to-use.

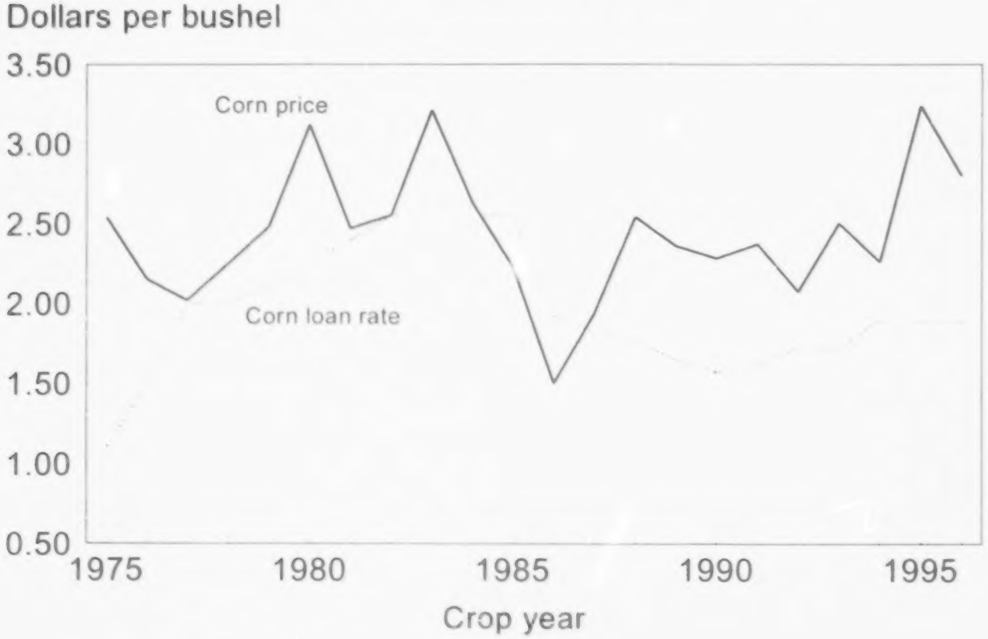
To represent the effects of Governmental price support programs on prices, many grain price models have been estimated with the dependent variable of price minus loan rate. The Baker and Menzie annual corn price model and part of the Van Meir analysis of corn prices and stocks used this approach, as did most of the unpublished USDA models. The U.S. price support program affected grain prices, particularly in the late-1970s through the mid-1980s. During this period, the support program's loan rate for corn was generally high enough to influence market prices. However, changes in the price support program since 1986 have resulted in less interference of that program with price determination.

Price Support and Commodity Storage Programs for Corn

The commodity price support program for corn allows producers to receive a loan from the Government at a designated loan rate per unit of production by pledging some of their corn production as loan collateral. Following harvest of the corn crop, a farmer who has enrolled in the corn program may obtain a loan for some portion of the new crop. For each bushel put under loan and pledged as loan collateral, the farmer receives a per-bushel amount equal to that year's loan rate. Under the loan program, the producer must keep the crop designated as loan collateral in approved storage to preserve the crop's quality. The producer may repay the loan at any time during the length of the loan, usually 9 months. However, at the end of the 9-month loan period, the farmer may choose instead to default on the loan rather than repaying it, keeping the loan money and forfeiting ownership of the loan collateral (the corn) to the Government. Defaulting on the loan would make economic sense for the producer if the market prices were below the loan rate, because the producer would effectively have received the loan rate for the crop rather than the lower market price.

Historically, loan rates were set high relative to market prices in the late 1970s through the mid-1980s (see figure 1). Loan program defaults resulted in the acquisition of corn by the Government, and Government stocks of corn reached over 1.1 billion bushels in 1982, or 15 percent of annual use. Also, a multi-year Farmer-Owned Reserve program was begun in the late-1970s, which provided storage subsidies to farmers to store grain under loan for 3 to 5 years. Additional price support was provided under Farmer-Owned Reserve program in some years. The long duration of this storage program combined with high release prices needed for grain to exit the reserve effectively isolated a large amount of grain from the marketplace. By 1982, corn held in the Farmer-Owned

Figure 1. Corn price and loan rate



Reserve rose to almost 1.9 billion bushels, about 26 percent of annual use.

Changes in the price support program since 1986 have resulted in less interference of that program with price determination. Farm legislation enacted in 1985 significantly changed the loan program and the effect of price supports on market prices, starting in 1986. Prices supports for grains were sharply reduced. The loan rate for corn was lowered from $2.55 per bushel for 1985 to $1.92 per bushel in 1986. Additionally, no further corn was permitted to enter the Farmer-Owned Reserve during 1986-1990. Also, corn in the reserve was more accessible to the marketplace as a new policy instrument introduced under the 1985 farm law, generic certificates, allowed early access to grain in the reserve before its contract expiration. Essentially, the loan program continued to provide producers a source of short term liquidity, but it no longer supported corn prices.

Policy changes since 1990 have continued to keep the price supporting aspects of the loan program at a minimum. Since 1986, the corn loan rate has ranged from $1.57 per bushel to $1.92 per bushel, well below market prices for corn in most years. Implementation of marketing loans for corn starting in 1993, which allow repayment of loans at less than the original loan rate, further reduced the loan program's potential effect on market prices. As a consequence, since 1986, price determination for corn has largely occurred in the marketplace based on supply and demand conditions without the influence of the Government price support program.

The Model

The general framework used here relating prices to ending stocks derives from an equilibrium model. In its simplest form, without the Government price support program, supply, demand, and stocks are each a function of price, with the market-clearing, equilibrium condition of determining the price at which supply equals demand plus stocks (equations 1-4).

(1) $S = f(p)$ (Supply function)

(2) $D = g(p)$ (Demand function)

(3) $K = h(p)$ (Stocks function)

(4) $S - D - K = 0$ (Equilibrium condition)

S is supply, D is demand, K is ending stocks, and p is market price. Supply is positively related to price while demand and stocks are negatively related to price.

In equilibrium, prices can be determined from the inverse of the supply, demand, or stocks function. Taking the inverse of the stocks function provides a price determination equation, with prices negatively related to stocks.

(5) $p = h^{-1}(K)$ (Inverse stocks function; price equation)

Introducing the Government price support loan program adds to the stocks function by incorporating the commodity loan rate to the function, as represented in equation 3a.

(3a) $K' = h(p; LR)$ (Stocks function with Government loan program)

K' is the revised stocks function and LR represents the loan rate. The Government loan program provides an additional feature to stockholding behavior that depends on the loan rate incentive to use the loan program.

With this alternative stocks function, the inverse stocks function gives the following price determination equation.

(5a) $p = h^{-1}(K'; LR)$

Prices would be expected to be negatively related to stocks. Prices would be expected to be positively related to the loan rate, particularly in those years that loan rates were set high relative to market clearing price levels and the Farmer-Owned Reserve isolated stocks from the marketplace, thereby resulting in interference of the loan program with price determination.

Model Implementation

The functional form used to estimate equation 5a for annual corn prices is logarithmic. Semi-log and exponential functional forms can alternatively be used and provide similar estimation results to those presented here.

(6) $$\mathrm{Ln}(p) = a + b\,\mathrm{Ln}(K'/U) + c\,\mathrm{Ln}(LR) * \mathrm{Dum7985}$$

U represents annual corn utilization, Dum7985 represents a dummy variable equal to 1 in 1979-1985 and equal to 0 in other years, and a, b, and c are parameters to be estimated.

In equation 6, stocks (K') are measured relative to an indicator of the "scale of activity" in the corn sector, represented by the realized level of demand, actual utilization (U). This adjustment is needed because of growth in the corn sector over the last 20 years, so a particular level of stocks today represents a smaller portion of total use (or realized industry demand) than the same level of stocks in 1975. The result is a stocks-to-use variable commonly used in price models, providing a measure of relative market tightness for the commodity. The expected sign of the stocks-to-use coefficient (b) is negative.

The interaction term of the loan rate (LR) times the dummy variable (Dum7985) represents the effects of the loan program on corn prices from the late-1970s through the mid-1980s. The years chosen for the interaction term were when the commodity loan program, in conjunction with the structure of the Farmer-Owned Reserve program, resulted in the loan rate interfering with the sector reaching its market clearing price level. Loan rates were relatively high in those years and the multi-year Farmer-Owned Reserve program, with high release prices, isolated those reserve stocks from the market. The price supporting aspects of the loan program in those years imply that the expected sign for the coefficient (c) for the loan rate interaction term is positive.

The specification of the interaction term represents an intercept shift related to the loan rate rather than a slope shift related to the stocks-to-use variable. An alternative specification that included a slope shift adjustment for 1979-1985 produced a result that was not statistically significant.

Farm-level prices used to estimate the model are season average prices collected by the U.S. Department of Agriculture's National Agricultural Statistics Service and re-published in the Economic Research Service's *Feed Situation and Outlook Yearbook* (March 1997). Stocks, utilization, and loan rate data also are from the *Feed Situation and Outlook Yearbook*.

Model Results

The model was estimated using ordinary least squares regression, with annual data from 1975 through 1996. The estimated logarithmic regression equation is

$$
\begin{aligned}
(7) \quad \mathrm{Ln}\,(p) &= \underset{(19.2)}{1.539} - \underset{(9.1)}{0.2426}\ \mathrm{Ln}\,(K'/U) \\
&\quad + \underset{(7.3)}{0.2896}\ \mathrm{Ln}\,(LR) * \mathrm{Dum7985} \\
R^2 &= 0.845 \qquad \mathrm{D.W.} = 1.854
\end{aligned}
$$

with t-statistics shown in parentheses under each coefficient.

Over 84 percent of the variation in annual corn prices is explained by estimated equation 7. Each coefficient has the expected sign, with a negative sign for the stocks-to-use variable and a positive sign for the loan rate shift variable. Each coefficient is significant at the 1 percent level.

A graph of the regression equation results is shown in figure 2, adjusting from logarithms to levels of each variable. Corn prices are plotted against ending stocks-to-use ratios. The circles in figure 2 represent the historical observations for the 1975-1996 estimation period. The lower price curve applies for all years except 1979-1985 and represents the equation that would currently be used for forecasting corn prices. The higher price curve represents the years 1979-1985, which incorporates the average price supporting effect of high loan rates in those years. The average difference between the 2 price curves for the 1979-1985 period is about 60 cents a bushel.

Model Evaluation

Figure 3 shows a graph of the predicted values derived from estimated equation 7 along with the actual corn prices. In general, the price model tracks actual corn prices well. Most differences between the model estimate and the actual corn price are less than 15 cents a bushel. The largest difference is in 1988, the year of a major drought in the Corn Belt region of the United States.

Figure 2. Corn price equation

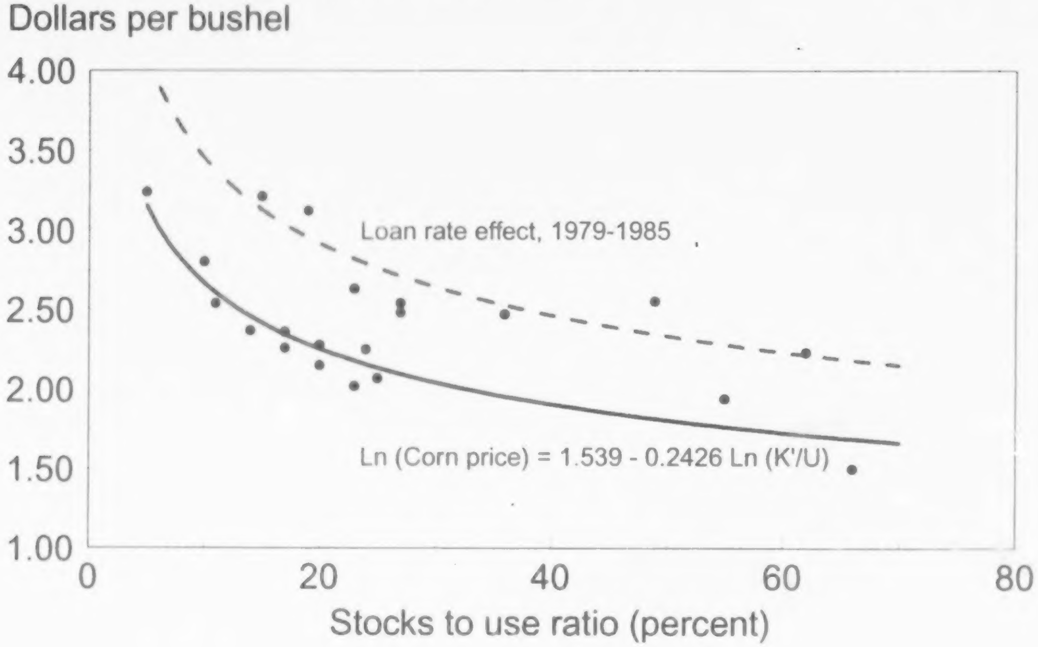


Figure 3. Corn prices--Actual and model estimate

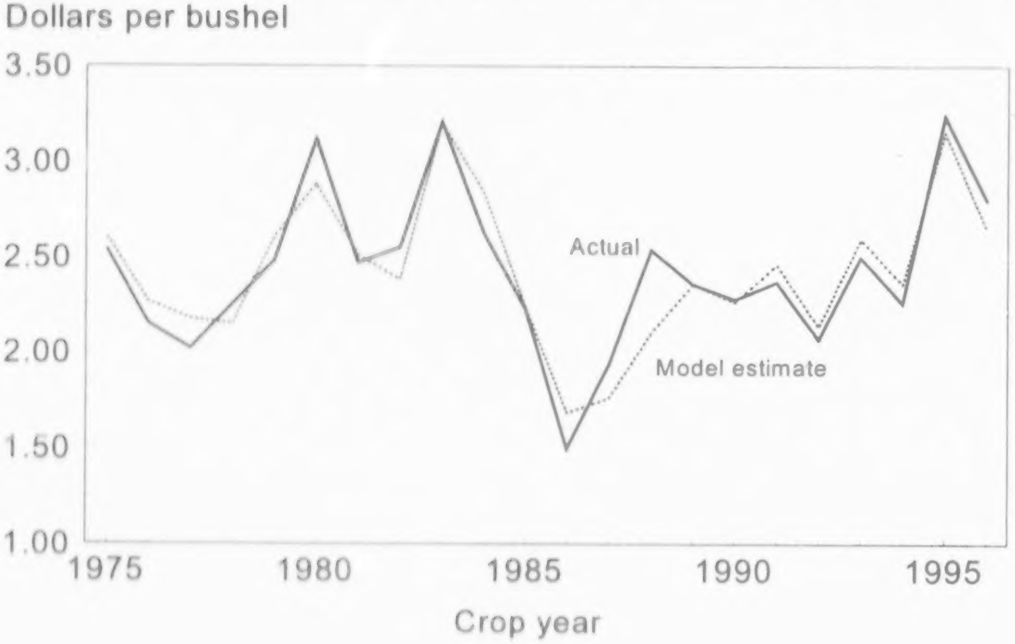


Table 1--Model performance measures, selected periods

Time period	Mean absolute error	Mean absolute percentage error
	Cents per bushel	*Percent*
1975-1996	12.1	5.1
1990-1996	9.7	4.6

Table 1 shows mean absolute errors and mean absolute percentage errors for the full estimation period, 1975-1996, and for a selected subsample of recent years covering 1990-1996. For the full sample, the mean absolute error is about 12 cents a bushel, with a mean absolute percentage error of about 5 percent. Importantly, for price forecasting applications, model performance is somewhat better in recent years (the 1990s), with a mean absolute error under 10 cents a bushel and a mean absolute percentage error of 4.6 percent. These statistical performance measures indicate good performance for the corn price model.

Conclusions

The corn price model presented in this paper uses a stocks-to-use ratio formulation. The model also addresses issues regarding the historical influence of Government commodity loan and storage programs on corn price determination. Loan programs are shown to have had an effect on corn prices in the late-1970s through mid-1980s. However, with farm program changes of 1985 farm legislation, lower loan rates and other features of commodity loan and storage programs have not had as much influence on prices over the last decade. Price determination now occurs in the marketplace, based on supply and demand factors. The stocks-to-use ratio used in the model captures these market effects.

The statistical performance measures as well as the graph of actual prices and model estimates indicate good performance for the corn price model. This is particularly the case given the large range of corn prices over the sample period used to estimate the model (1975-1996) as well as the changing nature of the influence of Government programs on corn price determination.

The relatively simple structure of the estimated reduced form model for corn prices and the model's minimal data requirements lend itself to easy use in corn price forecasting applications in conjunction with market analysis of supply and demand conditions. In particular, the model is used within USDA as part of the Department's short-term market analysis and long-term projections activities.

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FORECASTING WORLD COTTON PRICES

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This paper presents a forecasting model used by the Economic Research Service (ERS) of USDA for its contribution to the unpublished forecasts of the Department's Interagency Cotton Estimates Committee. USDA does not publish any cotton price forecasts, and its unpublished price forecasts are not directly derived from this or any other single model.

Since 1929, Congress has forbidden USDA from publishing forecasts of cotton prices (see Townsend for a discussion of the circumstances surrounding this legislation). However, commodity price forecasting by USDA is not solely geared towards publication, and the Department's Interagency Cotton Estimates Committee calculates unpublished estimates of world and domestic cotton prices each month. This paper details a single equation forecasting model for world cotton prices used to assist ERS in its contribution to the USDA price forecasts. Several aspects of the model's specification are discussed in the context of developments in U.S. and foreign cotton markets over the last 25 years. The model is based on the relationship between price, consumption, and stocks, and also attempts to account for the wide variety of policies in the United States and overseas.

World Prices

There are a wide variety of prices available for any given major commodity, each associated with a specific location and function. Determining which price is "the" world price is occasionally difficult, and even widely accepted choices involve trade-offs between varying degrees of specificity and generality. At USDA, world prices for wheat, corn, and soybeans are generally accepted to be described by the Agricultural Marketing Services (AMS) prices at U.S. Gulf Ports (USDA). The drawbacks to this choice include the loss in generality stemming from fixing the price to a specific quality from a single origin. At times, world corn markets may be influenced by different factors than those heavily weighing on number 3 corn or U.S. corn.

An average per-unit value--like an import unit value or average price received by farmers--may generalize with respect to origin or quality, but has the disadvantage of potentially varying as the shares of origins or qualities vary.

For cotton, an average of price quotes for a specific quality of cotton (middling 1-3/32") grown in various regions, but quoted for delivery in Northern Europe, has become accepted as a measure of the world price. This average is published daily by Cotlook Limited, and is known as the A-index. Cotlook Limited has registered the Cotlook A-index as a trademark, and each issue of *Cotton Outlook* magazine details how the index is derived. U.S. legislation has led to the adoption of an index identical to the A-index to help trigger policy decisions for the U.S. cotton marketing loan program (MacDonald). Thus, forecasts of the A-index are useful to both public and private sector policy-makers.

The Model

Assuming production of cotton is fixed before the beginning of the marketing year, then the following equilibrium model of the cotton market[1] can be specified:

Supply, $S = Q$

Demand, $C = f(P)$

Stocks, $I = g(P)$

$$S - C - I = 0$$

where: Q is amount of crop production for that given year (plantings depend of previous year's price, and the size of the harvest is determined before the beginning of the marketing year, although it is not necessarily all immediately available at that time) and P is price. Prices can be determined from the inverse of either the consumption or stocks function. Taking the inverse of the consumption function yields a price determination equation with prices directly related to consumption,

$$p = f^{-1}(C)$$

Following Westcott, this consumption variable is measured relative to a "scale of availability" in the cotton sector, represented by the realized end of year stocks (I). Textile production is a capital-intensive process, and is most profitable when machinery operates continuously. A rate of consumption that suggested a depletion of the current year's cotton supply before the availability of the following year's harvest would suggest a period during which textile producers would have no income to meet their fixed costs. Uncertainty regarding the size, timing, and transportation of the following year's crop suggests consumption should never be large enough to completely deplete the year's supply by, or even shortly after, the end of the year. Thus, we are left with a relationship stating prices are directly proportional to the ratio of consumption and ending stocks, and the implication that over a long time period this proportionality can shift as the risk of beginning the next marketing year with low supplies varies,

$$p = f^{-1} (C / I , z)$$

where z is the set of exogenous factors that can shift the relationship between current year price and use/stocks. Figure 1 illustrates how trends in inflation-adjusted cotton prices and global use/stocks have varied since 1971. The growing divergence between these two variables suggests the relationship has not been constant.

In this model the exogenous shift variables include: dummies representing different U.S. agricultural policy regimes, dummies for a few years of specific economic or policy shocks, variables capturing the impact of U.S. payments to cotton exporters (under a program that has made payments to both domestic users and exporters of cotton), and variables capturing consumers' expectations of changes in the cost of consuming cotton. A real U.S. exchange rate is also included as a separate variable since much of the world's consumption occurs in economies where neither costs nor returns are calculated in U.S. dollars. This could be specified by adjusting the A-index (which is reported in terms of U.S. currency) by the exchange rate. However, exchange rate changes are not exactly the same as changes in product prices (Goldstein and Khan), so the exchange rate was used as an explanatory variable, and the price remained in U.S. currency.

Given the somewhat ad-hoc nature of the exogenous shift variables introduced into the model, hypothesis testing of parameter values is not reliable. However, the model is still suitable for forecasting purposes since the large number of explanatory variables (11) suggests the danger is greater that the model includes irrelevant variables than is the danger that it omits relevant variables. Omitting relevant variables introduces bias and inconsistency into the parameter estimates for the included variables, in most cases (Pindyck and Rubinfeld). Irrelevant variables reduce efficiency but do not introduce bias or inconsistency, and, when the concern is with forecasting rather than hypothesis testing, the cost of mistakenly excluding a relevant variable is greater than the cost of including one that is irrelevant. Therefore, some variables for which theory suggests inclusion, but test statistics suggest omission, remain in the model.

Data

The dependent variable (P) was an unweighted marketing year average of the daily A-index in U.S. currency, adjusted by the U.S. GDP deflator. This is the deflator used for all the real prices in USDA's baseline forecasts. The stocks variable (I) is world ending stocks according to USDA's official database, minus China's ending stocks. Similarly, the consumption variable (C) is world consumption minus China's consumption, plus an additional factor. The additional factor added to consumption is net imports by China. These data are published in USDA's *Cotton and Wool Situation and Outlook Yearbook*. These adjustments largely reflect the uncertainty regarding the actual amount of cotton produced, consumed, and stored in China. One source of this uncertainty is the lack of a clear relationship between China's apparent domestic cotton supplies and its trade volume. Regardless of whether or not China's consumption and stocks have been correctly estimated, China's government prevents the rest of the world from accessing China's stocks at will, and prevents consumers in China from accessing world stocks at will. In a given year, China's most important effect on world prices comes from its trade, which either adds to cotton consumption when China is a net importer, or effectively reduces world consumption when China is a net exporter. These adjustments are similar to those followed by the International Cotton Advisory Committee (ICAC) in its world price forecasting model. One difference is that the ICAC includes China's trade as a separate variable rather than adding it to consumption or stocks.

Results

The model was estimated over 1971-95, since 1971 is initial year of the macroeconomic database developed for ERS's long-range baseline forecasting for the President's Budget (USDA). A semi-logarithmic functional form is used since the non-linear relationship captured turning points slightly better.

The estimated equation is (t-statistics in parentheses):

$$\begin{array}{lll} \text{Ln}(P) = 7.70 & - 0.47\ \text{Dum8695} & - 0.22\ \text{Dum9195} \\ \quad (23.8) & \quad (5.1) & \quad (3.0) \end{array}$$

$$\begin{array}{lll} - 0.29\ \text{Dum8485} & + 0.54\ \text{Dum73} & + 0.15\ \text{Dum7476} \\ \quad (3.9) & \quad (6.8) & \quad (2.8) \end{array}$$

$$\begin{array}{llll} - 0.74\ \text{Step2} & -0.44\ \text{Step2d} & + 2.87\ \text{Infl} & - 0.45\ \text{Prodd} \\ \quad (0.5) & \quad (1.0) & \quad (1.97) & \quad (2.6) \end{array}$$

$$\begin{array}{ll} - 0.004\ \text{Xr} & + 0.18\ \text{C/I} \\ \quad (1.97) & \quad (3.9) \end{array}$$

$$R^2 = .98 \qquad \text{D.W.} = 2.54$$

Figure 2 illustrates the performance of the estimated model.

Dum8695 is a variable with the value of 1 during 1986-1995 and zero otherwise. Dum9195 is a variable with the value 1 during 1991-1995 and zero otherwise. These dummies correspond to shifts in U.S. agricultural policy which significantly changed the relationship between prices and stockholding for all commodities in the United States, the world's largest cotton stockholder throughout much of the period analyzed. The United States has held as much as 35 percent of the world's non-Chinese stocks before 1986, but has remained below 20 percent every year since 1988.

Recall the divergence in trends in prices and the world use/stock ratio illustrated in Figure 1. While some of this divergence represents improvements in global communication, transportation, and trade that reduce the risk of not holding stocks, a large part of the divergence represents progressive changes in U.S. government efforts to keep U.S. cotton stocks off the market.

Dum8485 is a variable with the value 1 in 1984-1985 and 0 otherwise. It represents the combined effect of anticipation of the 1985 U.S. farm legislation and a shift in China's trade policy. The 1985 U.S. farm legislation lowered the high loan rates of the 1981 legislation and opened U.S. stocks to world markets for a variety of commodities. World prices fell in marketing year 1984 as the legislation took shape, partly in anticipation of lower prices in the subsequent year, and continued falling as lower priced production and pent-up stocks from the United States subsequently became available. These years also mark the initiation of large exports by China, only a few years after China had culminated 19 years of continuous net imports by becoming the world's largest importer. Between 1980 and 1985, China went from the world's largest importer to the world's largest exporter. China has generally been a net importer since then. Thus, it is not altogether clear if Dum8485 is capturing just the effect of U.S. policy, Chinese policy, or both.

Dum73 and Dum7476 are variables with the value 1 in, respectively, 1973 and 1974-76. The first oil shock and the USSR's "great grain robbery" (Morgan) of the early 1970's introduced significant volatility into commodity prices. Efforts to capture the volatility in expectations associated with this price volatility through other variables such as inflation and exchange rates were not completely successful. Simple specification testing (Durbin-Watson statistics) indicated that a model that included the years 1971-76 with two associated dummies was superior to one that excluded these years. In general, a modeler must use judgement to distinguish between outliers that are so extreme that they suggest measurement error or similar flaws and events that contain valuable information about the process being modeled (Pindyck and Rubinfeld).

U.S. Marketing Loan Program

Step2 is expenditure on exported cotton in a given year by the U.S. government under Step 2 of the cotton marketing loan program, divided by the value of all U.S. cotton exports that year. Export values are from USDA's *Outlook for U.S. Agricultural Exports* and data on the spending for Step 2 are from USDA's Farm Service Agency. Direct expenditures to support exports are thereby converted into percent equivalents. Both the export and expenditure data are on a fiscal year, but the difference between fiscal and marketing year is only 2 months, and the two months are those typically with the lowest export activity.

Step 2 of the marketing loan program was introduced in the 1990 U.S. farm legislation (MacDonald), so the variable is zero before 1991. Note that this program is also available to domestic consumers of cotton, and was therefore unaffected by the Uruguay Round Agreement. However, the United States unilaterally modified the program in 1996 to shift the expenditures even further in favor of domestic cotton consumers. This suggests that the relationship between expenditures under Step 2 and prices will be different in the future than what has been estimated here.

The expected sign of this variable is negative, as is the expected sign of the other variable associated with the Step 2 program, Step2d. Step2d is the first difference of the Step2 variable. Since the expenditures on exported cotton under the Step 2 program acted like an export subsidy by a large exporter when they occurred during 1991-1995, they would be expected to lower the world price of the commodity (Tweeten). The Step2d variable is intended to capture the additional effect of changes in the expenditures. The Step 2 program is not in effect continuously, and if market participants assumed the previous year's expenditures were a guide to the current year, Step2d is the adjustment in their expectations.

Step 2 payments to exporters were equivalent to 2-3 percent of the value of global raw cotton trade in 1992 and 1993, and the relationship between U.S. and world prices appears to have shifted since the step 2 program began. During 1972-90, the average premium Memphis 1-3/32" cotton received in Northern Europe to the A-index was 3.4 percent (excluding the policy transition period just before the 1985 farm legislation took effect). During 1990-96 the average premium was 6.8 percent. The shift from 3.4 percent to 6.8 percent may stem from the introduction of a price wedge between U.S. and world cotton prices through the Step 2 program. Some of this price wedge would derive from higher U.S. prices, but some would derive from lower world prices (Tweeten). The t-statistics for these parameters do not support the hypothesis that either is significantly different from 0. But, as noted earlier, the specification of this model does not lend itself to hypothesis testing. Both variables remain in the model due to their ability to improve short-run forecasts when recent years of data are dropped from the sample, and out of sample forecasts derived for those years.

One difficulty in determining the impact of the Step 2 on world prices is that Step 2 payments are correlated with the appearance of inexpensive Central Asian cotton on world markets. The ICAC, rather than including Step 2 data in their model, incorporates the bartered share of Central Asian exports (ICAC) While theory suggests that payments like Step 2 would put a price wedge between U.S. and world prices, the widening gap between the price of U.S. cotton and the A-index may also reflect changes in the A-index. Low production costs and falling domestic demand within the Former Soviet Union (FSU) meant increased quantities of Central Asian cotton were available at extraordinarily low cost in the early 1990's. Significant quantities of FSU cotton were held by former consumers which had acquired cotton under traditional barter arrangements, and marketing outside of the FSU was novel for Central Asian exporters. Thus much of the cotton left Central Asia under barter arrangements, resulting in its availability on world markets for low prices when sold for convertible currencies. Illustrative of the shift in costs to non-FSU markets is the shift in Central Asian cotton's rank among exporters: from a typical position of the third least expensive cotton in the world during the late 1980's, to consistently the least expensive during the early 1990's. More recently it has ranked closer to second least expensive.

Prices were particularly low during the 1992 marketing year when, in addition to the influx of Central Asian cotton, China was a net exporter for the only time between 1988-96, and India was exporting after an unusual decline in its cotton consumption. Much of the marketing year 1993/94 Step 2 export expenditures were based on commitments made during the 1992/93.

Other Variables

Expectations of exogenous changes in the future cost of procuring cotton are assumed to be encompassed by current year inflation and by an average change in production over the last 2 years.

Infl is the annual percent change in the U.S. GDP deflator. It has been assumed that consumers and stockholders believe the current year's inflation rate is the best guide to future inflation, which influences their willingness to accept a given price at a given use/stocks ratio. If inflation is higher, they will accept a higher price, since it reduces the likelihood they will be able to consummate postponed transactions later at a lower price. The estimated parameter has the expected positive sign.

Prodd is the average of the percent difference between the previous year's world production (excluding China) and each of the preceding 2 years. The preceding year is used because current year's actual production is generally not known until late in the year. While it is a safe assumption that the size of the crop is largely determined before the year begins, the poor communication and transportation infrastructure of the developing countries that account for much of the world's cotton production mean that early season estimates of production are unreliable.

Also, since developing countries heavily intervene in their economies, the price signals their producers receive are often at variance from those suggested by world prices. The best guide to the nature of the price signals many cotton producers receive, and to their ability to respond to them, is the resulting change in production. Since much of government economic policy, and the shifts in weather and insect pressures that influence yields, are exogenous from world price signals, it is appropriate to incorporate the past performance information as an instrument representing these complex factors in a consumer's calculation of an appropriate price. As Prodd rises (declines) it is indicative of a rising (falling) exogenous trend in cotton availability, and price should fall (rise). Thus, the expected sign of the estimated parameter is negative. The estimated parameter's sign is in accordance with this expectation.

Finally, Xr is the International Monetary Fund's trade-weighted, real exchange rate index for the United States. Weighting exchange rates by some other measure than the value of U.S. merchandise trade might seem appropriate, but since a significant portion of cotton imports are for producing textiles whose ultimate consumption occurs in developing countries, the IMF's weights seemed generalizable.

As the index rises, the strength of the dollar increases, and the cost of cotton in other currencies rises. Thus, as the exchange rate index rises, foreign consumers are less willing to pay a given price in dollars, and the expected sign of the exchange rate variable parameter estimate is negative. The estimate's sign is in accordance with this expectation.

Conclusions

Forecasting a price open to as many changing influences as the A-index is difficult. Even after years of global economic liberalization, government intervention in world cotton markets is significant. The second largest consumer of cotton in the world, India, continues to regulate its exports through quotas, and the second largest exporter, Uzbekistan, seems impervious to changes in world prices.

This model has been built by step-wise regression over several years. The variables associated with the Step 2 program are the only variables in the model where t-statistics show a pronounced lack of significance. They remain in the model nonetheless since theory suggests a they will affect prices, and because out of sample testing with truncated data sets gives far more accurate estimates for 1994 and 1995. The change in the Step 2 program since 1996 also means that even correctly modeling the impact of the program on past prices will be insufficient for forecasting prices in the future.

The mean absolute percent error of the model is 4.4 percent over 1971-1995, and the error for its first out of sample estimate (1996) is 4.7 percent. While this is promising, the new U.S. Step 2 program, and the possible specification errors concerning some of the other variables, suggest that further stepwise revisions in this forecasting model will be needed.

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Figure 1--World Price and Use/Stocks

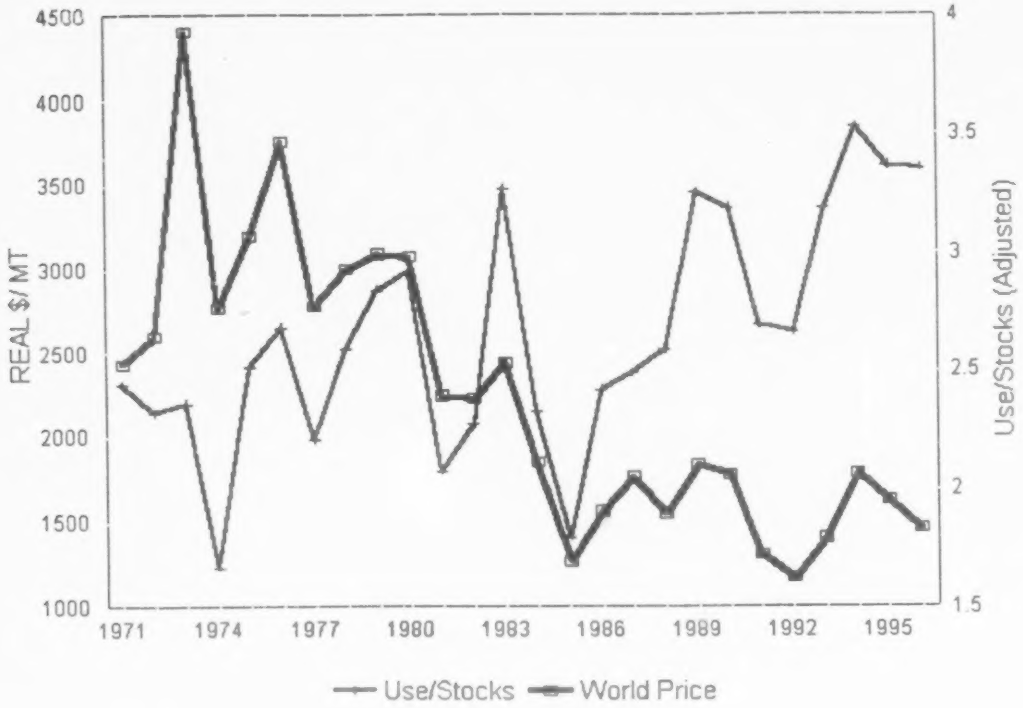
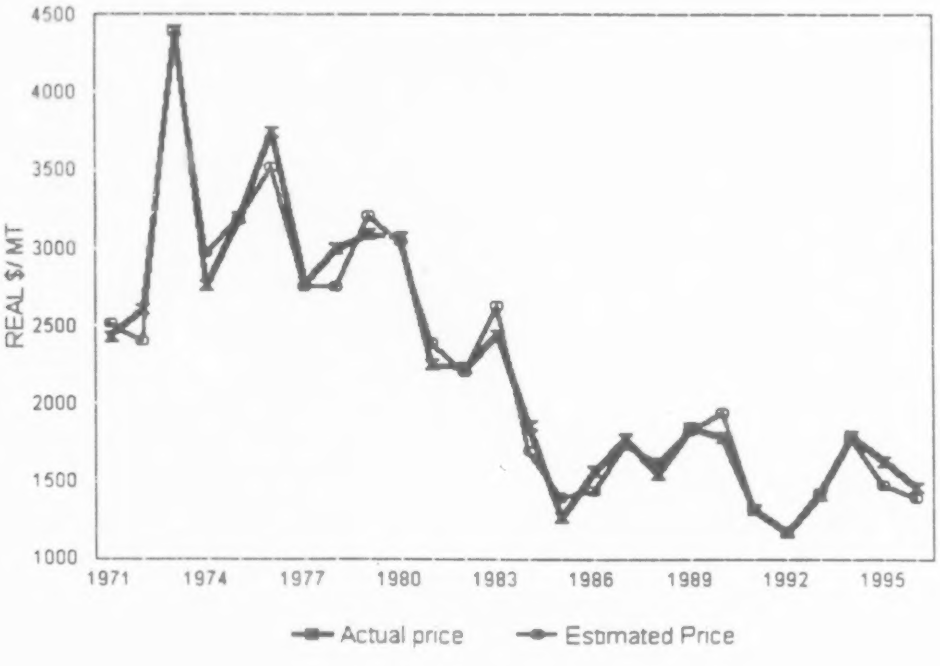


Figure 2--World Cotton Price



FORECAST EVALUATION

Chair: Norman C. Saunders
Bureau of Labor Statistics, U.S. Department of Labor

An Evaluation of the Census Bureau's 1995 to 2025 State Population Projections—One Year Later
Paul R. Campbell, Bureau of the Census
U.S. Department of Commerce

Evaluating the 1995 BLS Labor Force Projections,
Howard N Fullerton, Jr., Bureau of Labor Statistics
U.S. Department of Labor

Industry Employment Projections, 1995: An Evaluation,
Arthur Andreassen, Bureau of Labor Statistics
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Evaluating the 1995 Occupational Employment Projections,
Carolyn M. Veneri, Bureau of Labor Statistics
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"An Evaluation of the Census Bureau's 1995 to 2025 State Population Projections -- One Year Later"

Paul R. Campbell, U.S. Bureau of the Census and the Federal Forecasters Conference

Abstract. This paper evaluates the Census Bureau's 1996 state population projection results using recent population estimates.[1] Besides reporting on the accuracy of the projections, the paper evaluates the components used in the projections. The results and discussions are useful in identifying which components of change - births, deaths, interstate migration, and international migration - need to be further refined in order to improve future state population projections produced by the Census Bureau.

Introduction. One step toward improving a frequently used population projection model is to examine the accuracy of the results. This study examines the results of the Census Bureau's recent state projections for July 1, 1996 using the latest available state estimates for the same date. The detailed methodology and results for the state projections for the 1995-2025 period are available in Population Paper Listing 47 (PPL-47, see Campbell, 1996a). Besides state population projection totals this paper also examines the components of population change: births, deaths, state-to-state migration, and net international migration. The evaluation of projections against post-census estimates is an important quality control tool for both the producers and users of the projections. This evaluation considers the reliability of the projections, identifies changes in population trends, and addresses' issues related to the efficiency of the current projection model.

The Census Bureau's state population projections have recently been evaluated by the producers of the projections, see Campbell (1996b), Wetrogan and Campbell (1990), and Sink (1989 and 1990), as well as other researchers, Smith and Sincich (1992), interested in accuracy and bias. While demographers at the Census Bureau are frequently evaluating their elaborate projection model to improve the quality of the results, others are concerned with identifying competing models that may yield just as reliable results.

Some researchers have classified and compared various sources of state population projection totals, including those produced by the Census Bureau. Smith and Sincich (1992) have identified four general categories: (1) trend projections, where historical trends in states total population are extrapolated using mathematical formulas or statistical techniques; (2) ratio projections, where state population is expressed as a proportion of the nation and the historical trends in proportions are extrapolated and applied to independent projections of the national population; (3) cohort-component projections, where births, deaths, and migration are projected separately for each age-sex cohort in the states population; and (4) structural-causal projections, where relating population change to economic and/or other variables are used to project state population. In some instances these categories overlap.

Smith and Sincich (1992) have evaluated various state population projections for the 1960 to 1990 period -- several trend and ratio extrapolation techniques, an ARIMA time series model, the Census Bureau's cohort-component model, and structural models developed by the Bureau of Economic Analysis (which relates migration to projections in employment) and the National Planning Association (economic based model). They used the Mean Absolute Percentage Error (MAPE), which is the average error when the direction of error (i.e., positive or negative) are ignored, as well as several other techniques that measure forecast error. They found no support for the argument that complex and/or sophisticated projection techniques produce more accurate or less biased forecasts than simple, naive techniques. Nevertheless, less complex projection models usually do not produce as much detailed demographic information.

This paper first describes the evaluation techniques used in this study and gives a brief overview of the Census Bureau's state population estimates and projections methodology used to obtain 1996 figures. Second, the evaluation undertaken compares 1996 state population projection totals with corresponding state population estimates. Next, 1995-96 state population projection components of change are compared with corresponding state estimates. Finally, the conclusions section summarizes the implications of the results for the improvement of future state population projections.

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[1] This paper was presented earlier at the Population Association of America Meeting, Washington, DC, March 1997.

Methods. The Census Bureau's population projections are not forecasts (or predictions) of future populations. However, the evaluation of population projections is often referred to as the measurement of forecast error. Smith and Sincich (1992) note that forecast error refers to the percentage difference between a population projection and the 'true' population enumerated or estimated for the same year. To evaluate forecast error in this study, the mean absolute percentage error (MAPE) was derived, where:

$$MAPE=(100/n)\cdot\Sigma[|projection-estimate|/estimate]$$

MAPE's were developed for the United States (the states and the District of Columbia), where n equaled 51, and for each census region or division, where n equaled the number of states in each region or division (see Armstrong, 1978, and Smith and Sincich, 1992, for several alternative forecast error measurements).

Additionally, the net and percent population differences at the state level are used to compare the projections and estimates. The results show the size and direction of growth in the state populations and their components of change.

There can be some problems with aggregation over states to get MAPEs (or other statistics) if states differ in the predictability of their population. For instance, percent differences and MAPEs (1) cannot be calculated when either populations or components equal zero, or (2) are not very meaningful when percentages are greater than 100 percent.

State Estimates for 1996. State population estimates used to measure forecast error in the state population projections were derived from the Census Bureau's annual county estimates. These estimates were obtained from a demographic procedure called the "component change" method (U.S. Bureau of the Census, 1996a, and U.S. Department of Commerce, 1996). The "component change" method update's population estimates using administrative records data for counties. The county population estimates for 1996 were derived from the continuous process of updating the 1990 enumerated census population distributions. State estimates were obtained by summing up the appropriate county estimates. For a detailed discussion on the production of state and county estimates, see Byerly and Deardorff (1995).

It is important to note that the 1995 (one year-out) state projection totals are more consistent with preliminary state estimate totals, since the 1995 projections are summed prorata to the preliminary 1995 state estimates by age and sex (released in January 1996, see U.S. Bureau of the Census, 1996b). In other words, the 1995 total state population estimates (released during January 1996, U.S. Bureau of the Census, 1996a) are a second round of state population estimates. The state estimates are not 'truth', since subnational estimates are likely to be updated again as corrections or revisions to administrative records data become available during the post-censal period. The 'true' state population estimates may not be completed until the next census has been taken and an intercensal evaluation is completed. What this implies is that for 1995 an evaluation is available for preliminary 1995 state population estimate totals using revised 1995 state population estimate totals, see Table 1.

Until the state population estimates for the 1990's are accepted as 'truth', the 1996 state estimates (released in December 1996) may not be an ideal evaluation standard. The 1996 estimates are likely to be updated when the 1997 subnational estimates are released, as well as after the 2000 census. However, it appears that current state estimates are sufficient for an early comparison to provide useful information. The resulting MAPEs for the preliminary 1995 state estimates and the updated 1995 state estimates in Table 1 suggest that error in the 1995 estimates are fairly low. The 1995 MAPEs are much lower than the one year-out results in previous evaluations (Campbell, 1996b).

State Projections for 1996. The Census Bureau's state population projection model is a complex demographic model that projects the geographic growth of populations by accounting for annual ,aging, fertility, mortality, internal migration, and international migration of state populations. State population projections prepared for July 1, 1995 to 2025 use the cohort-component method. Each component of population change -- births, deaths, internal migration (domestic or state-to-state migration flows), and international migration (immigration and emigration) -- requires separate projection assumptions for each birth cohort by single year of age, sex, race, and Hispanic origin. The race and Hispanic origin groups projected were non-Hispanic White; non-Hispanic Black; non-Hispanic American Indian, Eskimo, and Aleut; non-Hispanic Asian and Pacific Islander; Hispanic White, Hispanic Black, Hispanic American Indian, Eskimo, and Aleut; and Hispanic Asian and Pacific Islander. The detailed components used in the state population projections are derived from vital statistics, administrative records, 1990 census data, state population estimates (U.S. Bureau of the Census, 1996c), and the middle series of the national population projections (in report P25-1130, see Day, 1996).

The cohort-component method is based on the traditional demographic accounting system:

$$P_1 = P_0 + B - D + DIM - DOM + IIM - IOM$$

where:

P_1 = population at the end of the period
P_0 = population at the beginning of the period
B = births during the period
D = deaths during the period
DIM = domestic in-migration during the period
DOM = domestic out-migration during the period (Both DIM and DOM are aggregations of the state-to-state migration flows)
IIM = international in-migration during the period
IOM = international out-migration during the period

To produce population projections with this model, separate data sets were created for each component. Detailed assumptions and procedures by which these data were generated by single year of age, sex, race, and Hispanic origin are described in report PPL-47 (Campbell, 1996a). Overall the assumptions concerning the future levels of fertility, mortality, and international migration are consistent with the assumptions developed for the national population projections (Day, 1996).

Once the data for each component were developed, the cohort-component method was applied producing the detailed demographic projections. For each projection year the base population for each state was disaggregated into race and Hispanic origin categories (the eight groups previously identified), by sex, and single year of age (0 to 85+). Components of change are individually applied to each group to project the next year's population. Survival rates were used to survive each age-sex-race/ethnic[2] group forward one year. The internal redistribution of the population was accomplished by applying the appropriate state-to-state migration rates to the survived population in each state. The projected out-migrations were subtracted from the state of origin and added to the state of destination (as in-migrants). Next, the appropriate number of immigrants from abroad were added to each group, while emigrants were subtracted. The populations under one year of age were created by applying the appropriate age-race/ethnic-specific birth rates to females of childbearing age. The number of births by sex and race/ethnicity were survived forward and exposed to the appropriate migration rate to yield the population under one year of age. The results for each age group were adjusted to be consistent with the national population projections by single years of age, sex, and race/ethnicity.[3] The entire process was then repeated for each year of the projections.

Although, two sets of state population projections were prepared, the only component specified differently in each projection model was the domestic migration component. The dynamic possibilities of change in state-to-state migration makes it the most difficult component to forecast. Migration trends projected in Report PPL-47 are based on matched Internal Revenue Service (IRS) tax return data sets containing 19 annual observations (from 1975-76 to 1993-94) on each of the 2,550 state-to-state migration flows.[4] The two projection series provide users with different scenarios based on past domestic migration trends. Both sets of state projections are summed and adjusted by age, sex, race and Hispanic origin to agree with the national population projection middle series. A brief description of each series follows: (1) Series A uses a time series model. The first five years of projections use the time series projections exclusively. The next ten years of projections are interpolated from the time series projections toward the mean of the series, while the final 15 years use the series mean exclusively. (2) Series B is an economic model. Changes in state-to-state migration rates are derived from the Bureau of Economic Analysis projected changes in employment in the origin and the destination states.

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[2] Hispanic origin is referred to as an ethnic group. Hispanic origin may be any race group.

[3] The state projections for one year-out are a special case because they were controlled first to the 1995 national population projections by age, sex, race, and Hispanic origin; and second to the preliminary 1995 state estimates, which were only available by age and sex.

[4] Evaluation of the migration models was performed by withholding the recent data and using the models to predict the withheld data (i.e., 1975-76 to 1992-93 data were used to predict 1993-94). For a discussion of the evaluation of previous migration models see Sink (1990).

Findings -- Table 1 presents a comparison of the MAPEs for the Census Bureau's 1996 state population projections (both Series A and B). These projections represent a lead time of two years-out from the base year of 1994. Examining the MAPEs for the United States, its regions, and its divisions suggests that most results in Series B were slightly more accurate than those in Series A. As noted earlier, the 1995 MAPEs for the state population totals, in table 1, should be viewed as estimate error between the first round (or preliminary) state estimates and the second round of the state estimates.

In Series A, the maximum MAPEs for the 1996 division projections was 0.8 percent compared to 0.7 percent for Series B. Most division projections were within 0.4 percent of the estimates, see Figure 1. For both Series A and B, the results for the West are much worse than for the rest of the country.

Table 2 presents a comparison of the net and percent differences between the projected and estimated total populations for the United States, regions, divisions, and states. In essence, it shows which states have the most accurate projection results. In Series A for 1996 projections, states ranged from -2.0 to 1.6 percent difference between the projections and estimates, while Series B had a slightly narrower range of percent differences from -1.9 to 1.3 percent. Outliers in Series A showing the greatest percent differences between projections and estimates were Arizona (-2.0 percent), Idaho (1.0 percent), Alaska (1.2 percent), Hawaii (1.4 percent), and Wyoming (1.6 percent). Three of the same outliers (Arizona 1.9 percent, Hawaii 1.1 percent, and Wyoming 1.3 percent) were found in Series B, see Figures 2 and 3. Except for outliers, states' percent differences in 1996 were fairly accurate, ranging from less than plus or minus 1.0 percent.

Components of Change for 1996. The components of change account for the growth or decline in state population. The comparison of the state projection components of change in report PPL-47 with corresponding state estimate components of change in press release CB96-224 (see U.S. Department of Commerce, 1996) is useful to identify the accuracy of the birth, death, net internal migration, and net international migration components.

The states' fertility and mortality rates were projected following trends (i.e., rate of change) in corresponding national rates. However, the states' annual fertility and mortality components (annual vital events, i.e., total births and total deaths) were not controlled or summed to corresponding national projection components. International migration rates for states were assumed to be constant and consistently follow national trends over the 30-year projection period. In the present evaluation, the states estimated internal migration component includes federal citizens movement[5]. The residual component calculated for state estimates was excluded.[6] The residual component is the net difference between the sum of the states' components of change and the national controls.[7]

One should be cautious in comparing the state estimates and projections components of change, since this involves several inconsistences. There are five reasons for being cautious in comparing the net and percent differences on the components of population change. First, the state estimates and projections use different data sets and methodologies. State projections use a cohort component model and many static assumptions, while state estimates use a county "component change" model. Second, when the state estimates components are close to zero and very different from state projections components; the resulting percent differences can be extremely large (more than 100 percent). The percent difference also cannot be calculated when the state component equals zero. Third, the state estimates and projections models diverge in their demographic accounting of the movement of the domestic and international migration components. When the components of change are summed (i.e., births - deaths, +/- domestic migration, +/- international migration), the results equal the net population change for the states estimates for 1995-96. The components of change for the state projections are not controlled back to the national totals; therefore, the sum of the components does not equal to the net population change in the state projections for the periods studied. Fourth, residual changes introduced through state and national controls can cause problems for this evaluation in the state projections, since some net differences (or residual differences) are introduced when the projections are summed and adjusted to the age and sex distribution of the national population projections. Finally, the error in one component may compound errors in other components. For example, projecting too many migrants increases the population, which may raise the number of births, if they are a more youthful population. This analysis identifies which components of change account for the most errors in the projections.

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[5] "Federal citizen movement component is the net movement of federally associated civilians and military personnel to each state from outside the country," see U.S. Bureau of the Census (1996a).

[6] The exclusion of the residual component from the state estimates and projections components imply that the sum of the components shown in table 3 will not equal the net population change.

[7] "Residual is the effect of national controls on subnational estimates. It is the difference between the implementation of the national estimates model and the county/state estimates models." U.S. Bureau of the Census, 1996a.

Findings -- Estimated components of population change for states shown in Table 3 identify the gains or declines of state population through births, deaths, internal migration, and international migration for the period July 1, 1995 to July 1, 1996. Among the four regions, the West and South, followed by the Midwest, had the fastest growth.

Fertility and mortality levels are expected to be static or slow to change in comparison to changes in migration trends. Consequently, projected birth and death components are likely to be more accurate than projected internal migration or international migration components. Although natural increase (births minus deaths) has played a major role in this growth, domestic migration in the South and international migration in the West accounted for the regional differences. Areas having the greatest population losses through domestic migration were the Middle Atlantic states in the Northeast and the Pacific states in the West.

Table 4 shows the results of calculating 1996 components of change MAPEs for Series A projections in report PPL-47 using the most recent state population estimates. The birth component is the most accurate component for most regions and divisions, followed by the death component. While both migration components are major sources of error in the state projections, domestic migration is consistently the least accurate component across all regions and divisions. Additionally, the MAPEs for the domestic migration components are the highest (greater than 100 percent) in the West, Midwest, and South regions, see Figure 4.

Table 5 shows the net and percent differences between the projected and estimated components of state population change for 1996. The results show the general accuracy of each component of change. Clearly, the birth component is the most accurate, followed by the death component. The direction of the error varied with about half the states having too many birth and the other half having too few births, while deaths were most often too high for most states. The fertility and mortality methodology in the current projections need to be further reviewed to identify the reasons for (1) predicting too many deaths for most states and (2) a number of outliers on both components with a difference of 10 percent or more.

As expected, the major sources of errors in the state projections were the state-to-state migration component, followed by the international migration component. Frequently, both projected migration components are too low, however, in these projections, the domestic migration was too high for most states, while immigration was too low. Contrary to these findings, California, with the largest share of the nation's domestic and international movement, was too low on the domestic migration component (projected in excess of 207,874 out-migrants in 1996) and too high on immigration (a surplus of 44,907 immigrants in 1996).

Conclusions. The MAPEs calculated using state population totals imply that the projections are fairly accurate (less than 0.5 percent error) for all regions but the West. Furthermore, the current two years-out projection results are within the range of forecast error found in previous state projection results one year-out (see Table 6).

The high net and percent differences for several states in the West point to the difficulty of the migration models in predicting turning points or the reversal in migration streams. Clearly, states like Alaska, Arizona, Hawaii, and California are outliers (with the least accurate projections) in the current and previous sets of projections.

This was the second time an economics model was used to predict domestic migration flows. In this instance, the economics model (Series B), which uses inputs from the Bureau of Economic Analysis, produced slightly more accurate projections than the time series model (Series A). The economic model, seems useful, but also failed to predict reversal or turn-around in migration trends. Future refinements of the current economic model may be hampered by the fact that current subnational economic projections may not be updated.

Past evaluations -- In essence, the evaluation process began with the examination of the internal migration component long before each set of state projections was produced. The internal migration component, the most difficult component to predict, often suffers the greatest loss of accuracy over the projection horizon. Past evaluations of our internal migration models indicated that the mean predicts more accurately than our time series model for projections ten or more years out, to which the necessary adjustments were made.[8]

Similar to previous projections those in report PPL-47 do not adequately predict turning points in the domestic migration flows. It appears that these changes are linked regionally, which may require more complex modeling to predict trends. For example, as California began to have losses through domestic migration, other states in the region began to show rapid growth. International immigration also peaked during 1992-93 then began to decline. For an evaluation of forecast errors in previous state projections in Current Population Report P25-1111, see Campbell, 1996b and 1994.

Implications for Future Projections -- This evaluation did not attempt to examine the methodological errors introduced by other differences in the projections and estimates. Several methodological problems that are likely to contribute to projection inaccuracies are as follows: (1) dated domestic and international migration rates based on the retrospective data from the 1990 census; (2) projections based on inadequate or incomplete baseline race and Hispanic origin characteristics; and (3) problems caused by controlling the projections to the national estimates and projections, and less detailed state estimates. The state-to-state migration models used in the projections makes no attempt to forecast turning points in migration. The recurring problem of failing to produce accurate projections for states in the West suggests that perhaps more attention should be directed to the potential for changes in those states with more rapid growth than in the past. Perhaps, a sub-state projection model would better capture and extrapolate emerging migration trends than the current state-to-state projection model.

Future work on state population projections at the Census Bureau will explore the possibility of producing sub-state level projections. For instance, metropolitan - nonmetropolitan projections may identify counter sub-state migration trends that could improve our ability to project state populations accurately.

Additionally, the current state projections were constrained by pressures from users for more demographic characteristics based on less detailed data and fewer staff resources. The future evaluation and tracking of the Census Bureau's state population projections on detailed demographic characteristics (age, sex, race, and Hispanic origin) should further identify the essential refinements necessary to produce more accurate state population projections.

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[8] Smith and Sincich (1990) evaluating several simple forecasting techniques for state projections found that 10 years of base data are adequate for accurate projections, however more lengthy base period data are needed for long-range forecasts for the most rapidly growing states.

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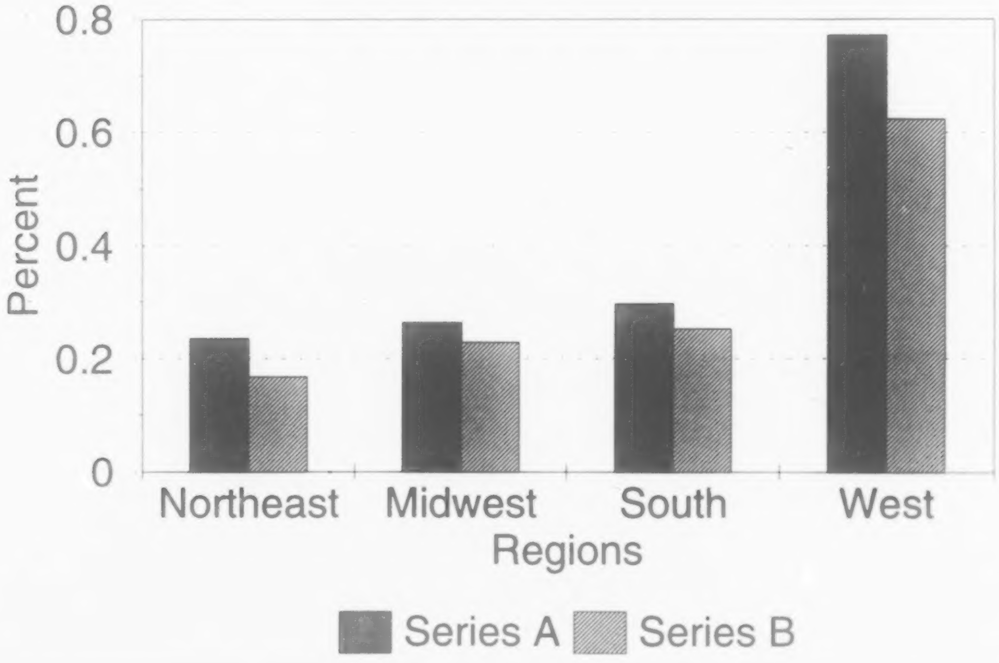
Fig.1 MAPEs for State Projections

Series A and B: 1996



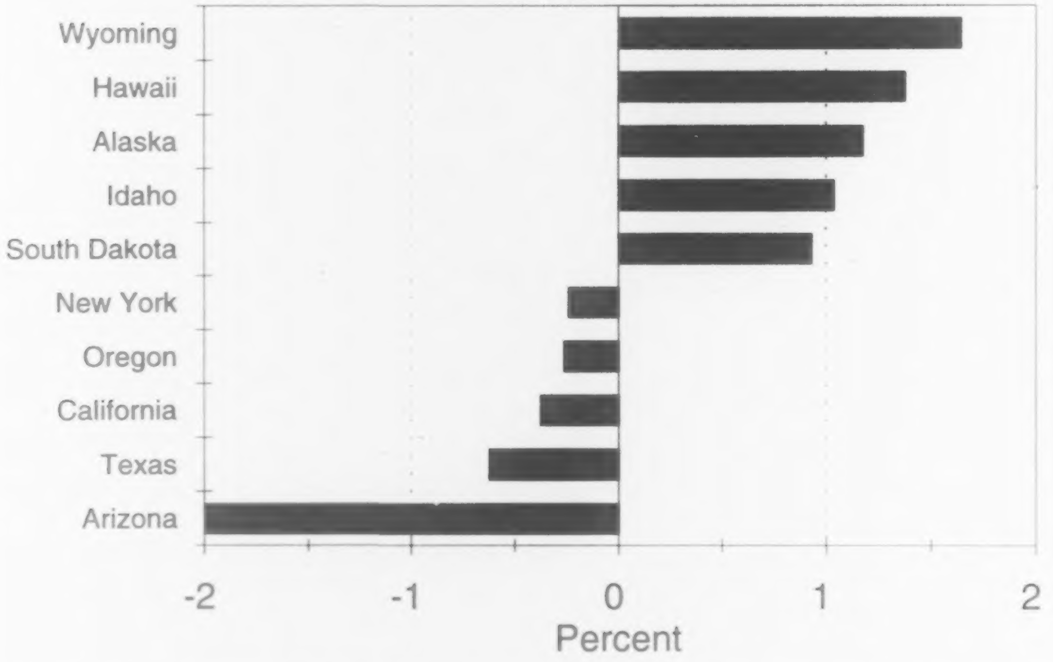
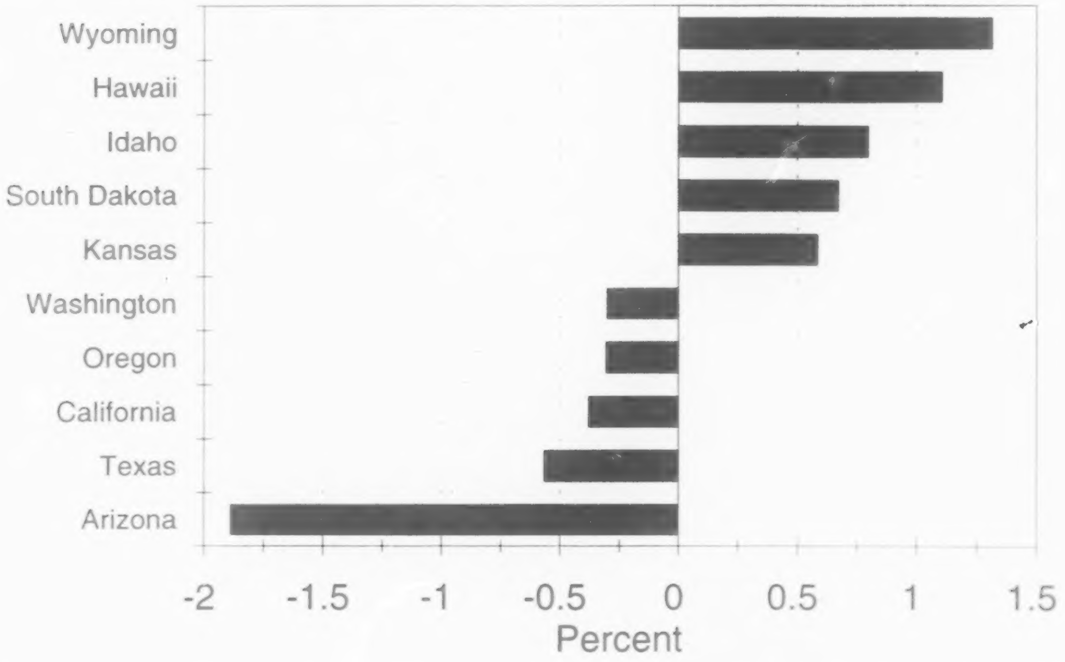


Fig. 2 Highest and Lowest Percent
Difference Series A 1996

Fig. 3 Highest and Lowest Percent

Difference Series B 1996



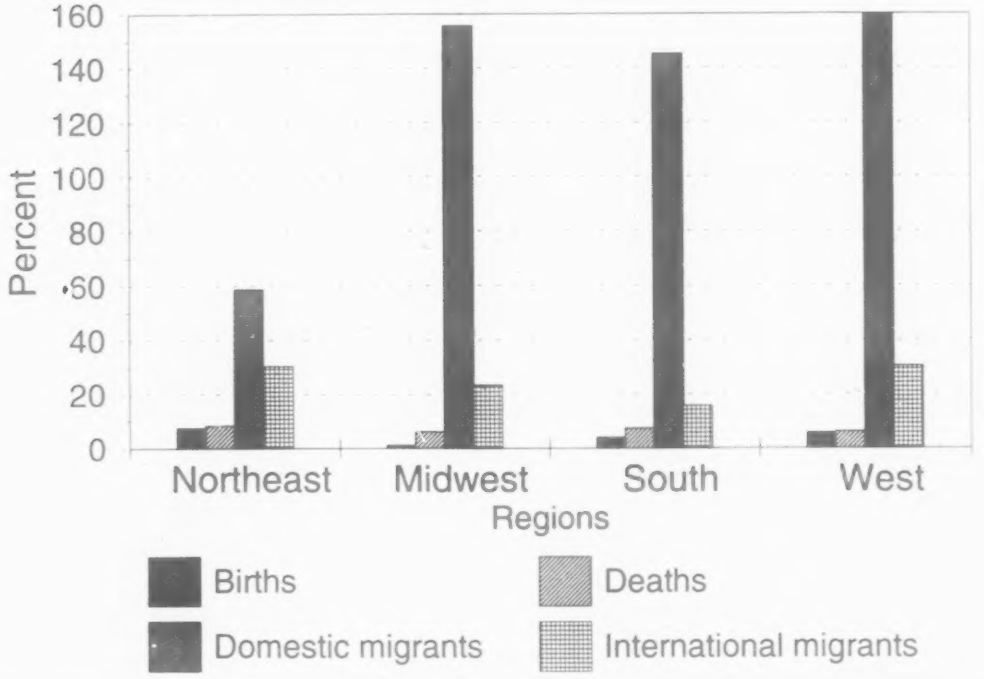


Fig. 4 MAPEs for Components of Change for Regions, Series A: 1996

Table 1. Mean Absolute Percentage Error for State Estimates 1995 and State Projections 1996

Regions and divisions	1995 Estimates	1996 Projections	
		Series A	Series B
United States	0.18	0.40	0.33
Northeast	**0.11**	**0.24**	**0.17**
New England	0.10	0.22	0.12
Middle Atlantic	0.15	0.26	0.26
Midwest	**0.10**	**0.26**	**0.23**
East North Central	0.15	0.19	0.19
West North Central	0.07	0.31	0.25
South	**0.12**	**0.30**	**0.25**
South Atlantic	0.09	0.29	0.22
East South Central	0.12	0.31	0.30
West South Central	0.16	0.29	0.27
West	**0.37**	**0.77**	**0.62**
Mountain	0.42	0.83	0.68
Pacific	0.29	0.68	0.53

1995 Estimates: Mean absolute percentage error (MAPE's) based on an initial set of state population estimates released January 1996 and a revised set of state population estimates released December 1996. Data from PE-45 diskettes and press release CB96-224.

1996 Projections: Results for 2 years-out from the 1994 base year population. MAPEs are based on State population projections from report PPL-47 and State population esimates in press release CB96-224.

Table 2. Population Estimates, Net and Percent Difference between Projected and Estimated Population, by Series and Geography: 1996

Regions, Divisions, and States	Population estimate	Series A Net difference	Series A Percent difference	Series B Net difference	Series B Percent difference
United States	265,283,783	(30,254)	-0.01	(30,351)	-0.01
Northeast	**51,580,085**	**36,954**	**0.07**	**44,920**	**0.09**
New England	13,351,266	22,131	0.17	18,408	0.14
Middle Atlantic	38,228,819	14,823	0.04	26,512	0.07
Midwest	**62,082,428**	**95,524**	**0.15**	**99,713**	**0.16**
East North Central	43,613,999	59,285	0.14	71,731	0.16
West North Central	18,468,429	36,239	0.20	27,982	0.15
South	**93,097,801**	**(12,775)**	**-0.01**	**(4,292)**	**-0.00**
South Atlantic	47,615,690	43,438	0.09	42,742	0.09
East South Central	16,192,576	53,398	0.33	51,165	0.32
West South Central	29,289,535	(109,611)	-0.37	(98,199)	-0.34
West	**58,523,469**	**(149,957)**	**-0.26**	**(170,692)**	**-0.29**
Mountain	16,117,831	(33,174)	-0.21	(40,660)	-0.25
Pacific	42,405,638	(116,783)	-0.28	(130,032)	-0.31
New England:					
Maine	1,243,316	2,044	0.16	106	0.01
New Hampshire	1,162,481	3,013	0.26	1,380	0.12
Vermont	588,654	3,185	0.54	1,077	0.18
Massachusetts	6,092,352	8,667	0.14	12,495	0.21
Rhode Island	990,225	1,180	0.12	(859)	-0.09
Connecticut	3,274,238	4,042	0.12	4,209	0.13
Middle Atlantic:					
New York	18,184,774	(43,840)	-0.24	(36,773)	-0.20
New Jersey	7,987,933	9,947	0.12	11,990	0.15
Pennsylvania	12,056,112	48,716	0.40	51,295	0.43
East North Central:					
Ohio	11,172,782	18,233	0.16	22,353	0.20
Indiana	5,840,528	15,244	0.26	16,069	0.28
Illinois	11,846,544	31,772	0.27	35,292	0.30
Michigan	9,594,350	(12,970)	-0.14	(7,873)	-0.08
Wisconsin	5,159,795	7,006	0.14	5,890	0.11
West North Central:					
Minnesota	4,657,758	(873)	-0.02	(2,613)	-0.06
Iowa	2,851,792	2,568	0.09	525	0.02
Missouri	5,358,692	11,192	0.21	11,628	0.22
North Dakota	643,539	2,144	0.33	637	0.10
South Dakota	732,405	6,836	0.93	4,914	0.67
Nebraska	1,652,093	(587)	-0.04	(2,136)	-0.13
Kansas	2,572,150	14,959	0.58	15,027	0.58
South Atlantic:					
Delaware	724,842	3,345	0.46	1,373	0.19
Maryland	5,071,604	23,561	0.46	22,604	0.45
District of Columbia	543,213	2,134	0.39	1,797	0.33
Virginia	6,675,451	25,282	0.38	21,713	0.33
West Virginia	1,825,754	5,182	0.28	3,113	0.17
North Carolina	7,322,870	(4,824)	-0.07	(2,900)	-0.04
South Carolina	3,698,746	13,404	0.36	12,343	0.33
Georgia	7,353,225	(10,045)	-0.14	(7,643)	-0.10
Florida	14,399,985	(14,601)	-0.10	(9,658)	-0.07
East South Central:					
Kentucky	3,883,723	5,121	0.13	3,870	0.10
Tennessee	5,319,654	21,305	0.40	22,400	0.42
Alabama	4,273,084	21,108	0.49	18,401	0.43
Mississippi	2,716,115	5,864	0.22	6,494	0.24
West South Central:					
Arkansas	2,509,793	4,916	0.20	2,671	0.11
Louisiana	4,350,579	8,896	0.20	12,328	0.28
Oklahoma	3,300,902	(3,919)	-0.12	(4,704)	-0.14
Texas	19,128,261	(119,504)	-0.62	(108,494)	-0.57
Mountain:					
Montana	879,372	7,666	0.87	4,850	0.55
Idaho	1,189,251	12,382	1.04	9,480	0.80
Wyoming	481,400	7,907	1.64	6,325	1.31
Colorado	3,822,676	14,768	0.39	11,713	0.31
New Mexico	1,713,407	8,018	0.47	7,035	0.41
Arizona	4,428,068	(88,305)	-1.99	(83,525)	-1.89
Utah	2,000,494	3,393	0.17	3,189	0.16
Nevada	1,603,163	997	0.06	273	0.02
Pacific:					
Washington	5,532,939	(11,496)	-0.21	(16,675)	-0.30
Oregon	3,203,735	(8,429)	-0.26	(9,758)	-0.30
California	31,878,234	(120,298)	-0.38	(120,188)	-0.38
Alaska	607,007	7,132	1.17	3,531	0.58
Hawaii	1,183,723	16,308	1.38	13,058	1.10

Notes: Negative values are shown in parenthesis. Net difference obtained as projected populations minus estimated populations. Figures may not sum to totals due to rounding. Percent difference for each year equals (projection - estimate / estimate) * 100.
Sources: See text for details.

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Table 3. Estimated Components of Population Change, for States: July 1, 1995 to July 1, 1996

Regions, Divisions, and States	Births	Deaths	Domestic migrants	International migrants	Federal Citizen movement	Residual
United States	3,879,771	2,330,870	0	855,648	(10,400)	0
Northeast	**697,466**	**498,972**	**(326,392)**	**205,272**	**(483)**	**(2,297)**
New England	168,492	122,005	(30,215)	31,705	(186)	(1,636)
Middle Atlantic	528,974	376,967	(296,177)	173,567	(297)	(661)
Midwest	**877,611**	**575,484**	**(34,484)**	**84,896**	**(756)**	**(1,621)**
East North Central	624,684	400,929	(55,128)	65,828	(330)	(1,533)
West North Central	252,927	174,555	20,644	19,068	(426)	(88)
South	**1,349,597**	**835,673**	**381,868**	**247,706**	**(5,774)**	**1,869**
South Atlantic	654,419	440,302	244,254	147,735	(3,845)	292
East South Central	226,169	157,779	70,712	7,883	(573)	176
West South Central	469,009	237,592	66,902	92,088	(1,356)	1,401
West	**955,097**	**420,741**	**(20,992)**	**317,774**	**(3,387)**	**2,049**
Mountain	254,558	117,518	188,772	40,333	(714)	2,529
Pacific	700,539	303,223	(209,764)	277,441	(2,673)	(480)
New England:						
Maine	13,963	11,884	2,304	468	(35)	(72)
New Hampshire	14,993	9,408	7,723	935	(5)	(1)
Vermont	6,828	5,025	1,547	537	0	(9)
Massachusetts	75,029	56,400	(15,325)	19,069	(45)	(1,054)
Rhode Island	12,427	9,841	(5,967)	2,023	(26)	(92)
Connecticut	45,252	29,447	(20,497)	8,673	(75)	(408)
Middle Atlantic:						
New York	264,068	172,051	(216,831)	118,496	(170)	700
New Jersey	113,806	76,601	(39,346)	40,649	(88)	7
Pennsylvania	151,100	128,315	(40,000)	14,422	(39)	(1,368)
East North Central:						
Ohio	153,909	106,710	(14,802)	7,428	(68)	(1,007)
Indiana	83,216	53,923	10,707	3,795	(9)	(206)
Illinois	185,682	109,874	(58,353)	38,741	(232)	201
Michigan	134,206	84,414	(5,750)	12,881	(16)	(505)
Wisconsin	67,671	46,008	13,070	2,983	(5)	(16)
West North Central:						
Minnesota	63,493	38,197	11,640	6,227	(16)	(2)
Iowa	36,985	28,461	(1,998)	2,505	(1)	(312)
Missouri	72,919	54,919	16,867	4,410	(103)	183
North Dakota	8,508	6,139	(911)	655	(66)	(14)
South Dakota	10,487	7,091	(1,075)	600	(28)	12
Nebraska	23,319	15,519	3,309	1,810	(74)	35
Kansas	37,216	24,229	(7,188)	2,861	(138)	10
South Atlantic:						
Delaware	10,246	6,354	2,845	1,141	(33)	(44)
Maryland	71,934	42,675	(11,679)	15,457	(320)	(25)
District of Columbia	7,889	6,042	(17,205)	3,835	(45)	253
Virginia	91,115	52,423	2,436	19,591	(1,218)	716
West Virginia	21,238	20,462	(584)	468	(1)	(161)
North Carolina	101,293	65,152	77,947	7,025	(790)	212
South Carolina	50,649	33,617	12,416	2,454	(287)	131
Georgia	111,707	58,889	76,628	14,434	(519)	1,188
Florida	188,348	154,688	101,450	83,330	(632)	(1,978)
East South Central:						
Kentucky	52,080	37,304	10,439	1,864	(193)	(40)
Tennessee	73,094	51,458	48,188	3,033	(125)	199
Alabama	60,017	42,258	7,218	2,138	(129)	(107)
Mississippi	40,978	26,759	4,867	848	(126)	124
West South Central:						
Arkansas	35,141	26,770	15,626	1,037	(34)	32
Louisiana	65,118	39,766	(15,917)	3,115	(150)	107
Oklahoma	45,374	32,737	10,176	3,573	(228)	(126)
Texas	323,376	138,319	57,017	84,363	(944)	1,388
Mountain:						
Montana	11,175	7,794	5,205	333	(31)	133
Idaho	18,114	8,596	11,039	2,438	(29)	173
Wyoming	6,291	3,773	(640)	320	(28)	38
Colorado	54,541	25,192	36,049	9,410	(227)	535
New Mexico	26,944	12,708	4,692	4,719	(118)	29
Arizona	72,615	35,872	72,465	13,204	(178)	818
Utah	39,771	10,970	9,865	3,492	(39)	62
Nevada	25,107	12,613	50,097	6,417	(64)	741
Pacific:						
Washington	77,456	41,255	33,100	16,319	(450)	49
Oregon	42,918	28,559	33,386	7,118	(11)	28
California	551,744	223,978	(258,915)	246,376	(1,671)	(802)
Alaska	10,181	2,626	(4,150)	1,078	(153)	132
Hawaii	18,240	6,805	(13,185)	6,550	(388)	113

Note: Negative values are shown in parenthesis.

Sources: See text for details. Data reported in the U.S. Bureau of the Census, 1996, "Estimates of Population and Demographic Components of Change for States: Annual Time Series, 1990-96," ST-96-1, Population Division.

Table 4. Mean Absolute Percentage Error for State Projections Components of Change: 1996

Regions, Divisions, and States	Births	Deaths	Domestic migrants	International migrants
United States	4.4	7.0	136.1	23.90
Northeast	**7.5**	**8.3**	**58.7**	**30.38**
New England	9.3	7.7	72.3	42.82
Middle Atlantic	3.8	9.6	31.7	5.50
Midwest	**1.3**	**6.2**	**155.7**	**23.52**
East North Central	1.8	6.1	138.4	18.14
West North Central	0.9	6.3	168.1	27.37
South	**3.9**	**7.4**	**145.3**	**15.72**
South Atlantic	5.9	8.2	224.0	16.64
East South Central	1.2	5.9	77.0	11.01
West South Central	2.4	7.0	36.5	18.39
West	**5.7**	**6.1**	**159.7**	**30.46**
Mountain	5.9	3.5	223.2	42.87
Pacific	5.4	10.3	58.0	10.62

Sources: See text for details. Mean absolute percentage error based on state projections Series A from report PPL-47 and state estimates from PE-45 data files.

Table 5. Net and Percent Difference between Projected and Estimated Components of Population Change: 1995 and 1996

Regions, Divisions, and States	Births		Deaths		Domestic migrants*		International migrants	
	Net	Percent	Net	Percent	Net	Percent	Net	Percent
United States	68,686	1.77	169,586	7.28	10,402	-100.02	(33,074)	-3.87
Northeast	**38,851**	**5.57**	**50,068**	**10.03**	**15,660**	**-4.79**	**14,784**	**7.20**
New England	15,893	9.43	10,933	8.96	(19,035)	62.61	12,259	38.67
Middle Atlantic	22,958	4.34	39,135	10.38	34,695	-11.70	2,525	1.45
Midwest	**5,105**	**0.58**	**35,782**	**6.22**	**(6,540)**	**18.56**	**(5,726)**	**-6.74**
East North Central	5,123	0.82	24,976	6.23	(35,255)	63.57	(4,284)	-6.51
West North Central	(18)	-0.01	10,806	6.19	28,715	142.03	(1,442)	-7.56
South	**(4,935)**	**-0.37**	**47,533**	**5.69**	**97,848**	**26.02**	**(68,134)**	**-27.51**
South Atlantic	1,431	0.22	20,651	4.69	56,844	23.64	(24,562)	-16.63
East South Central	(2,612)	-1.15	8,664	5.49	28,502	40.64	900	11.42
West South Central	(3,754)	-0.80	18,218	7.67	12,502	19.07	(44,472)	-48.29
West	**29,665**	**3.11**	**36,203**	**8.60**	**(96,566)**	**396.10**	**26,002**	**8.18**
Mountain	(12,767)	-5.02	878	0.75	90,773	48.27	(15,287)	-37.90
Pacific	42,432	6.06	35,325	11.65	(187,339)	88.19	41,289	14.88
New England:								
Maine	1,639	11.74	846	7.12	(3,278)	-144.47	208	44.44
New Hampshire	791	5.28	266	2.83	1,025	13.28	162	17.33
Vermont	764	11.19	295	5.87	2,401	155.20	(245)	-45.62
Massachusetts	10,471	13.96	5,612	9.95	(14,778)	96.15	8,225	43.13
Rhode Island	1,544	12.42	1,039	10.56	(264)	4.41	1,618	79.98
Connecticut	684	1.51	2,875	9.76	(4,141)	20.13	2,291	26.42
Middle Atlantic:								
New York	14,432	5.47	22,280	12.95	(2,686)	1.24	5,063	4.27
New Jersey	1,475	1.30	5,181	6.76	10,304	-26.13	(1,201)	-2.95
Pennsylvania	7,051	4.67	11,674	9.10	27,077	-67.63	(1,337)	-9.27
East North Central:								
Ohio	1,539	1.00	5,773	5.41	(7,731)	51.99	708	9.53
Indiana	(2,302)	-2.77	2,598	4.82	7,919	74.02	35	0.92
Illinois	(470)	-0.25	8,099	7.37	(4,875)	8.32	(3,751)	-9.68
Michigan	5,934	4.42	5,631	6.67	(31,667)	549.20	(2,745)	-21.31
Wisconsin	422	0.62	2,875	6.25	1,099	8.41	1,469	49.25
West North Central:								
Minnesota	(219)	-0.34	2,168	5.68	715	6.15	25	0.40
Iowa	11	0.03	2,355	8.27	2,058	-102.95	166	6.63
Missouri	1,247	1.71	2,977	5.42	3,499	20.87	(908)	-20.59
North Dakota	67	0.79	289	4.71	1,836	-187.92	(227)	-34.66
South Dakota	(3)	-0.03	447	6.30	7,044	-638.62	(397)	-66.17
Nebraska	(445)	-1.91	1,239	7.98	2,032	62.81	(739)	-40.83
Kansas	(676)	-1.82	1,331	5.49	11,531	-157.40	638	22.30
South Atlantic:								
Delaware	136	1.33	451	7.10	3,088	109.82	(338)	-29.62
Maryland	2,052	2.85	1,894	4.44	10,161	-84.68	3,879	25.10
District of Columbia	2,498	31.66	2,073	34.31	1,199	-6.95	503	13.12
Virginia	2,111	2.32	3,622	6.91	17,766	1458.62	408	2.08
West Virginia	163	0.77	1,714	8.38	1,850	-316.24	(1)	-0.21
North Carolina	(3,049)	-3.01	2,488	3.82	1,683	2.18	(372)	-5.30
South Carolina	3,131	6.18	706	2.10	2,127	17.54	(430)	-17.52
Georgia	(4,344)	-3.89	1,761	2.99	3,143	4.13	(4,005)	-27.75
Florida	(1,267)	-0.67	5,942	3.84	15,827	15.70	(24,206)	-29.05
East South Central:								
Kentucky	(569)	-1.09	2,505	6.72	870	8.49	349	18.72
Tennessee	(2,009)	-2.75	1,317	2.56	10,120	21.06	266	8.77
Alabama	(245)	-0.41	2,781	6.58	13,041	183.96	240	11.23
Mississippi	211	0.51	2,061	7.70	4,471	94.30	45	5.31
West South Central:								
Arkansas	(1,023)	-2.91	1,579	5.90	5,875	37.68	1	0.10
Louisiana	2,951	4.53	3,103	7.80	1,000	-6.22	(172)	-5.52
Oklahoma	(215)	-0.47	1,994	6.09	(7,794)	-78.35	(575)	-16.09
Texas	(5,467)	-1.69	11,542	8.34	13,421	23.93	(43,726)	-51.83
Mountain:								
Montana	(50)	-0.45	244	3.13	6,868	132.74	135	40.54
Idaho	(1,435)	-7.92	334	3.89	17,230	156.49	(1,121)	-45.98
Wyoming	285	4.53	(6)	-0.16	6,384	-955.69	(164)	-51.25
Colorado	(1,423)	-2.61	935	3.71	19,977	55.77	(4,448)	-47.27
New Mexico	994	3.69	623	4.90	14,877	325.25	(3,736)	-79.17
Arizona	(4,099)	-5.64	(476)	-1.33	3,078	4.26	(2,867)	-21.71
Utah	(3,615)	-9.09	290	2.64	13,579	138.19	(685)	-19.62
Nevada	(3,424)	-13.64	(1,066)	-8.45	8,780	17.55	(2,401)	-37.42
Pacific:								
Washington	(1,009)	-1.30	2,380	5.77	6,049	18.53	(2,827)	-17.32
Oregon	(1,934)	-4.51	1,021	3.58	(408)	-1.22	(287)	-4.03
California	43,395	7.87	30,153	13.46	(207,874)	79.77	44,907	18.23
Alaska	536	5.26	(54)	-2.06	5,078	-118.01	(75)	-6.96
Hawaii	1,444	7.92	1,825	26.82	9,816	-72.32	(429)	-6.55

Notes: Negative values are in parenthesis.
Net difference equals projection - estimate. Percent difference for each year equals (projection - estimate) / estimate) * 100.
*Domestic migrants includes net movement of Federal Citizens from abroad to the States, so the nations total does not equal to zero.
Sources: Series A components of change from PPL-47 and PE-45, see text for details.

Table 6. Mean Absolute Percentage Error for State Projections from the Most Recent Census Bureau Publications

	Two year-out results		One year-out results						
Regions	Report PPL-47		Report P25-1111			Report P25-1053			Report P25-1017
	Series A	Series B	Series A	Series B	Series C	Series A	Series B	Series C	
United States	0.4	0.3	0.3	0.5	0.3	0.4	0.7	0.4	0.5
Northeast	0.2	0.2	0.3	0.6	0.3	0.3	0.5	0.4	0.2
Midwest	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2
South	0.3	0.3	0.2	0.3	0.2	0.3	0.7	0.3	0.4
West	0.8	0.6	0.5	0.9	0.5	0.6	1.1	0.7	1.1

Report PPL-47: Mean absolute percentage error (MAPEs) are based on State projections for 1996 two years-out from the 1994 starting points or base year.
Report P25-1111: MAPEs are based on State projections for 1993 one year-out from the 1992 starting points.
Report P25-1053: MAPEs are based on State projections for 1990 one year-out from the 1989 starting points.
Report P25-1017: MAPEs are based on State projections for 1989 one year-out from the 1988 starting points.

Sources: Various Census Bureau publications, see text for details and references.

EVALUATING THE 1995 BLS LABOR FORCE PROJECTIONS

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KEYWORDS: Mean absolute percent error, index of dissimilarity, growth rate errors

1. Introduction

The Bureau of Labor Statistic (BLS) has made labor force projections since the late 1950s. They have generally been for a 10 to 20 time span. These projections by age and sex, since the late 1970s, by race, and since the late 1980s, by Hispanic origin. Beginning in 1968, the Bureau of Labor Statistics has not considered the projection process complete until it assesses the accuracy of its projections (Swerdloff 1969). Such evaluations help the developers of the projections to better understand the causes of projection errors and provide users with information on the accuracy of specific components of the projections.

This article examines the errors in the labor force projections to 1995 and the sources of the errors. The analysis compares projected and actual (most recent Current Population Survey estimate) levels of the labor force and the rates of labor force participation of specific age groups for men and women, and for whites and blacks and others. Where appropriate, the accuracy of the six 1995 labor force projections are compared with evaluations of BLS projections of the 1985 and 1990 labor force (Fullerton 1988 and 1992). Each of the six labor force projections to 1995 are identified by the year in which they were published.

One of the challenges in evaluating projections is that the actual data are not strictly comparable to that projected. For example, the projections to 1985 were different from the actual 1985 numbers because of changes in how undocumented workers were estimated. Generally, some changes in the Current Population Survey are introduced after each census. The redesign after the 1990 census, implemented in 1994, was particularly extensive (Polivka and Miller 1994). Some changes affected the number of persons counted in the labor force, by adjusting for the census undercount. Other changes affected the proportion of the population for some demographic groups counted in the labor force. It is estimated that a slightly greater proportion of women are and a higher proportion of older persons are now placed in the labor force. It is not possible to quantify the effect of these improvements in the survey, so it is not possible to know how much they affect projection accuracy.

2. Evaluation of the aggregate 1995 projections

Each of the six projections to 1995 had three alternatives: high, moderate, and low. This analysis, for the most part, focuses on the middle or "moderate" growth projection in each series (Fullerton and Tschetter 1983, and Fullerton 1980, 1985, 1987, 1989, and 1991). (See table 1.) The following tabulation shows the projections to 1995 (in millions) and the numerical and the percent error made in each year the projections were developed.

Projection for 1995 made in:	*Labor force (millions)*	*Error*	
		Number	*Percent*
1980	127.5	-4.8	-3.6
1983	131.4	-0.9	-.7
1985	129.2	-3.1	-2.4
1987	131.6	-0.7	-.5
1989	133.2	0.9	.7
1991	134.1	1.8	1.3
1995	132.3		

The overall error was greatest in 1980 and 1985; the pattern of low but increasing error exhibited since 1987 is due to over projecting labor force participation slightly for most groups. In the past, BLS projected the male labor force too high and the female labor force too low. As table 1 indicates, in every year except 1991, men's labor force was projected too low. Previous evaluations indicated that the error for women's labor force was greater than that for men and that women's labor force was projected too low. In contrast to previous evaluations, this analysis shows only the 1980 and 1985 projections had women's labor force too low and only the 1991 labor force projection for women was worse than that for men. The two years with the largest errors were years in which the labor force for both men and women were too low.

Because whites make up about 85 percent of the labor force, the numerical errors for this group should be larger than for blacks and others; this was true for every projection except that made in 1983. However, because sampling variability, the relative error for blacks and others should be greater than their share of the labor force; this is also true.

Projections made for a longer time span should be less accurate that those made a shorter span. We adjust for different time spans by using annual growth rates. The following tabulation displays the growth rates for the total civilian labor force historically with the projected annual rate and the actual annual rate of change. All three rates are measured over the same number of years. The historic rate is calculated over the same number of years *before* the date of the projection as 1995 is *after* the date of the projection:

Projection for 1995 made in:	*Historical rate*	*Projected rate*	*Actual rate*	*Error*
		(in percent)		
1980	2.40	1.23	1.46	-.23
1983	2.42	1.36	1.42	-.05
1985	2.19	1.18	1.40	-.22
1987	1.95	1.24	1.30	-.06
1989	1.63	1.30	1.20	.10
1991	1.57	1.45	1.18	.27

The first two columns indicate that the Bureau expected labor force growth to slow, especially in the earlier projections. For example, in 1980, the labor force growth was expected to drop from the historical rate of growth, 2.4 percent a year, to 1.2 percent and in 1985 to drop from 2.2 percent yearly to 1.2 percent. In fact, the labor force did slow dramatically, though not by as much as BLS anticipated. Between 1989 and 1995 and between 1991 and 1995 however, the labor force growth slowed even more than BLS anticipated.

3. Population projections

The two components of BLS labor force projections are 1) age-race-sex specific labor force participation rates, made by BLS, and 2) age-race-sex specific population projections prepared by the Bureau of the Census (U. S. Bureau of the Census 1977, 1982, 1984, 1989). Analysis indicates that population increase underlies most of the labor force increase. (See, for example, Fullerton 1993). The past two evaluations of the labor force projections indicate that a major source of error has been not accounting for undocumented immigration in the population projections. Once the Census Bureau began incorporating an estimate of undocumented immigration into their population projections, the labor force projection error dropped significantly (Fullerton 1988, 1992). For this evaluation, there is an additional complication, the Current Population Survey estimates are adjusted for the 1990 census undercount which none of the population projections anticipated.

The following tabulation shows 1995 projections for the civilian, noninstitutional population aged 16 and over for men and women (in millions) and the errors associated with the total population projections:

Projection of 1995 population made in:	*Total*	*Men*	*Women*	*Error of Total (percent)*
		(in millions)		
1980	186	88	98	-6.3
1983	194	92	102	-2.4
1985	194	92	102	-2.4
1987	196	93	102	-1.4
1989	196	93	102	-1.4
1991	198	95	103	-.4
1995	199	95	103	

The source of population projection error for the ages of interest, 16 to 64, and for the time-span of these projections is net immigration. For an analysis of the effect of different assumptions embodied in the population projections on various age groups in the population in different time periods, see Long (1991).

The errors in the population projection declined as the projection period gets shorter. For the projections to 1995, the errors attributed to the population projections are uniformly lower than in earlier evaluations. Until 1989, the Bureau of the Census did not incorporate estimates of undocumented immigrants into the middle population projection series because such persons were not included in current population estimates. Once this was done, errors in the labor force projections attributed to errors in population projections dropped. The following tabulation shows total labor force errors attributable to participation and population errors (in millions):

Projection for 1995 made in:	*Total labor force error*	*Error attributed to:*	
		Participation	*Population*
	(in millions)		
1980	-4.8	11.7	-16.4
1983	-.9	10.0	-10.9
1985	-3.1	6.9	-10.0
1987	-.7	8.2	-8.9
1989	.9	10.0	-9.1
1991	1.8	8.9	-7.1

The most remarkable aspect of this tabulation is that in each projection the participation rate and the population errors offset each other. (See tables 2 and 3). There is no intrinsic reason why this should be. In fact for some earlier projections, the errors did not offset. The errors in the participation rate were derived by multiplying the 1995 annual average civilian noninstitutional population by the projected participation rates. Any difference between the these numbers and the 1995 annual average civilian labor force is due to labor force participation rate error. Comparing the error of the published projection with the errors attributable to participation rate projections yields the errors due to population projections. Not only do the errors in the population projection drop as the time horizon shortens, they shrink as a source of labor force projection error, becoming smaller than participation rate error by 1989.

Population projection errors were fairly evenly divided between men and women. If we expect more undocumented men than women, this is surprising. We would expect a greater error for men. It is also interesting to find that the number of those 60 to 69 were underprojected. Half the population error for white men was due to ages 55 and over for the 1980 projection. For the 1991 projection the errors for white men 60 and over exceeded the total error for white men. (There were small offsetting errors at the younger ages.) By race as a whole, the errors for whites were 80 percent of total error in the 1980 projection. This increased to 85 percent by the 1991 projection. Errors by race were in proportion to their population size.

4. Labor force participation rate error

Labor force participation rate error did not decrease as the projection period decreased. (See table 2.) Errors by race were roughly proportional to their share of the labor force. If anything, blacks and others error was slightly lower than their proportion of the labor force, especially for the earlier projections.

Projection errors by sex were not equally divided. Men accounted for 54 percent of the labor force, but from 38 to 45 percent of the error. Black and other men were accurately projected in the earlier projections to 1995. This may be attributed to chance. Because the labor force participation rates of men have not been changing as rapidly as that for women, it is easier to project their activity. Projections of the white women's labor force participation rates consisted of half the error in the 6 projections. Similarly, the projection for black and other women accounted for 10 percent of the error, almost twice their proportion of the labor force. Women's labor force was more dynamic and harder to project.

This analysis proceeded by multiplying the 1995 population estimate by the projected labor force participation rates for the six labor force projections and compare the resulting labor force with the actual level; another approach would be to compare the projected labor force participation rates with the 1995Current Population Survey estimates. (See table 4.)

5. Measures of errors in labor force participation

The later labor force projections were made for more age groups and more race or Hispanic origin groups than the earlier ones. For this analysis, 13 age groups were reviewed for men and women, for whites and blacks and others. If projections were made for additional groups, the totals for those groups are shown in table 1. The analysis of labor force participation rates was conducted on sets of 52 detailed participation rates. The evaluation of the projections to 1990 only reviewed 20 sets of labor force participation rates. Much of the work of bettering the labor force projections has come by providing more detail by age and race or Hispanic origin, not by increasing the sophistication of the projection.

The median error in labor force participation for each of the 52 errors per projection period ranged from 0.3 percentage points for the 1983 projection to 2.0 in the 1987 projection. (See chart 1.) However, none of the medians were significantly different from zero. (A median error of zero indicates that half the errors were above and half were below zero.) The range of median errors was much greater than for the projections analyzed for 1990. This reflects the use of smaller age groups and accounting explicitly for race.

Projection for 1995 made in:	*Median of error*	*Mean absolute deviation*
1980	1.22	5.6
1983	0.33	4.7
1985	1.00	3.8
1987	2.05	3.6
1989	1.81	2.8
1991	1.67	2.0

Despite the greater median of the errors, the spread of the errors, the mean absolute deviation or MAD, was less. The greatest over projection for the 1995 labor force was 16.7 percentage points (for white women 18 and 19 years of age, made in 1980). The lowest under projection, 10.6 percentage points (white men 65 to 69, made in 1985), was less than half the comparable error made in 1990. Generally speaking, the more aggregated the groupings, the smaller error we would expect. This suggests that there may have been a modest improvement in the projections over those made for 1990.

Another summary of the error often given for a wide variety of projections and forecasts is the mean absolute percentage error or MAPE. This measure attaches more significance to errors in the smaller groups.

Projection for 1995 made in:	*Mean absolute percentage error*	
	Level	*Participation rates*
1980	11.6	11.7
1983	11.2	12.7
1985	10.2	14.3
1987	9.4	11.7
1989	6.4	6.4
1991	4.2	4.0

The MAPE's for the *level* or overall projections show a satisfying decrease through time. The errors due to the population projection display the same patter. These measures indicate the importance of the population projection to the overall labor force projection error and that as time passed, the projection of the smaller groups improved. This also confirms the impression of lower spread of errors that the analysis using the median and the box-plot presents.

The MAPE's for the labor force *participation rates* show errors rising through the 1985 projection and then declining, with the MAPE for participation rates less than the MAPE for the overall projection. This pattern gives weight to the errors in the groups with lower participation, younger and older segments of the population. The analysis of the labor force errors due to participation based on comparing the labor force derived by combining the projected labor force participation rates with the actual population gives different information on the errors. The overall projection was fairly good because those groups with high attachment to the labor force were accurately projected. The groups with low attachment to the labor force (with low participation rates) were less accurately projected.

6. Errors in participation by age, sex, and race

As the discussion above shows, we know that the errors in labor force participation were greatest for young and older persons. For the 1980 projections, errors tended to be higher for young women than young men, while for the remaining projections, errors were generally greater for young men. Errors for young white men tended to be greater than for young black men, but white rates were over projected and black rates under projected in the early years. After 1983, rates for both groups of men were over projected. For young women, white rates were generally less accurate than young black women. Rates for both groups of young were likely to be too high. Over projection of labor force participation in the 1980 labor force projection extended into ages 25 to 29 for both groups of women.

The projected labor force participation for older people provided another source of error. Generally, the rates were projected too low. In part this error is due to the change in the CPS, which now counts more older persons in the labor force. However, for white men, this under projection of participation extended down to ages 50 to 54. The more recent labor force projections have had significantly lower errors for older people. The following tabulation shows the best and worst projection for each projection:

Projection for 1995 made in:	*Greatest over projection*	*Lowest under projection*
1980	16.7	-10.0
1983	12.6	-10.4
1985	9.3	-10.6
1987	7.8	-8.4
1989	6.5	-4.2
1991	4.8	-5.1

When the error in the participation rate is 5.1 percentage points and the participation rate for the group was 59 percent in 1995, the error is almost 9 percent. One may take the position that the percent error and not the percentage point error is a better measure of the accuracy. The 1980 labor force projection's greatest percent error was 34 percent, for white men ages 16 and 17. This was lower than the greatest percent error for other years. Generally, the 1980 projection was not the year with the lowest error. The projection for 1985 had the greatest percent error, 60 percent, for black men ages 70 and over. The groups that had the highest percent error had low labor force participation rates. So, they also have high percent errors. This set of projections had most of their errors in either the youngest or oldest members of the labor force.

Compared with the labor force projections to 1990, the relative errors are larger, the greatest relative error was 32 percent, made in 1973. The increase in relative errors may reflect the greater variability because of the smaller groups being projected. The error was for black women aged 65 to 69, such a small population group was not evaluated last time.

7. Composition errors

For some users of the projections, the key question is not "what is the level," or "how fast," but what proportion of the labor force is comprised of a particular group. This may be measured by the *index of dissimilarity* (White, 1986), which measures how much the projected distribution would have to change to be the actual

1980	1983	1985	1987	1989	1991
3.8	3.0	2.8	2.1	1.6	1.1

This measure indicates a steady improvement in projecting the labor force composition, by age, sex, and race. The greatest error (1980) is considerably lower than the greatest error in projections made to 1990. The least error is also smaller than the least error made in the projections to 1990. For those who rely of labor force projections to indicate the likely future composition of the labor force, these numbers offer reassurance. Increasing the number of groups evaluated may have reduced the size of this error. By looking at the projections made to both 1990 and 1995, it is possible to see if the improvement is due to more groups. For the projections made in 1980, 1983, and 1985, the errors are greater for the 1995 projections than the 1990 projections.

8. Alternative projections

For each projection, two alternative projections were made. Did the range from low-to-high alternatives span the actual? And, was the high or low alternative close to the 1995 actual? For evidence, we turn to chart 2, which shows the high and low alternatives for each of the six labor force projections to 1995. The actual is "covered" by the alternatives. The alternatives did function as confidence or credible intervals. Generally, the high projection was closer to the actual than the low projection. However, for the more recent projections, the low was closer.

The gap between high and low should narrow for the more recent projections. This happened, but the interval for the 1983 projection was wider than for the 1980 labor force projection. This reflects a decision made in 1983 that reflected the evaluation of the projections to 1980. The high alternative projection, beginning in 1987, has reflected higher net immigration. This implies higher labor force participation rates as well as higher population numbers. This is one reason the high alternative labor force projection increased between 1987 and 1989.

Summary

Overall Comparison. Ten measures of projection accuracy were made of the six labor force projections for 1995. Which projection was best? In considering this, there are several ways a projection can be best. For example, if the errors are offset, the projected level of the labor force would be very near the actual level, yet the participation rates and the projected population would be incorrectly projected. However, if the main use of the projected labor force was the level or growth of the labor force, the details would not matter. The following tabulation lists the number of times a projection of the 195 labor force was calculated to be best or worst:

Projection	*Best*	*Worst*
1980		6
1983	2	
1985	1	2
1987	1	1
1989	1	
1991	5	1

The tests described earlier help users evaluate the projections in terms of their own needs: for an accurate level of the total labor force, for accurate labor force participation rate projections, or for accurate projections of composition of the labor force. Different tests of the accuracy of the participation rate projections allow the user to focus on overall accuracy or accuracy of specific groups.

Earlier evaluations. Because the projections were evaluated at a greater level of detail than in the past, comparison with earlier projections is difficult. Evaluations of the accuracy of the level and of the growth rate are at the same level as in previous evaluations. Evaluations of the components, could look worse without being worse. An obvious questions is: Did the more detailed projections yield more accurate projections?

	Projection to 1995		*Projection to 1990*	
	Error	*Year*	*Error*	*Year*
Error level (in millions):				
Best	0.9	1989	.2	1980
Worst	-4.8	1980	-14.2	1970
Error in growth rate (percent):				
Best	-.05	1983	.02	1983
Worst	.27	1991	-.68	1973
Mean absolute percent error:				
Best	4.0	1991	6.8	1985
Worst	14.3	1985	10.8	1973
Index of dissimilarity:				
Best	1.1	1991	2.6	1985
Worst	3.8	1980	7.6	1973

The results are fascinating. In terms of the error in millions, for the projections made to 1990, those made in 1980 had the lowest error, but the 1980 projections were the worst (and longest) to 1995. The least error of the projections to 1995 was greater than the least error to 1990, but the worst error to 1995 was almost a third the worst error to 1990. If the error is measured by the annual growth rate, once again, the best (least error) for the 1995 projection was greater than the best projection to 1990, but the worst 1995 error was significantly better than the worst 1990 error. The 1991 projection to 1995 was the worst, even though it was the shortest. Focusing on the best projections to 1990 and 1995, leads one to say that the 1995 projections were not as good as the 1990 ones. Looking at the worst errors (MINIMAX) leads to the opposite conclusion.

Looking at the two remaining measures, which do reflect the greater detail evaluated, one gets a mixed picture. The best 1995 projection was better than the best projection made to 1990, but the worst to 1995 had a greater error than the worst 1990 projection. For the three projections that were evaluated earlier to 1990, the MAPE's for 1995 are higher than for 1990. The additional 5 years has resulted in lower accuracy. The highest MAPE for the 1995 projections is the same as the highest for the 1990 projections, but the two most recent projections have lower MAPE's than any of the projections to 1990. This suggests that the errors for the groups with lower participation rates were improved in the 1995 projections.

For those interested in the composition of the labor force, the index of dissimilarity indicates that the best projection to 1995 had an error less than half the best projection to 1990 and that the worst projection to 1995 had half the error of the worst projection to 1990.

The projection for 1990 made in 1983 had a greatest relative error of 17 percent, for 1995, the greatest relative error for the projection to 1995 made in 1983 was 53 percent. The greatest MAD was less than the greatest for 1990 and the least was just less than the least for 1990. The median MAD for 1995 (3.7) was less than the median MAD for 1990 (4.05). Even though the groups being analyzed in 1995 are smaller and thus more variable than the groups for 1990, the spread of errors is smaller. The greater variability resulted in the extreme errors being greater than in 1990.

BLS labor force projections to 1995 were marginally better than the projections to 1990 because the Bureau of the Census is projecting the population more accurately, because BLS is not projecting as far forward as in the past, and because the labor force itself is not growing as rapidly. However, the most stable population groups, white, non-Hispanics, are expected to be a smaller portion of the future labor force. Thus, future labor force projections may not be as accurate. As the baby boom ages, projecting their labor force activity at the older ages should also be more difficult.

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Table 1. The 1995 labor force, and labor force participation rates, actual and as projected in 1980, 1983, 1985, 1987, 1989, and 1991

Labor force group	Labor force (in thousands)							Participation rate (in percent)						
	As published in –						Actual	As published in –						Actual
	1980	1983	1985	1987	1989	1991	1995	1980	1983	1985	1987	1989	1991	1995
Total	127,542	131,387	129,168	131,598	133,215	134,085	132,304	68.6	67.8	66.6	67.2	68.1	67.8	66.6
Men, 16 and older	67,611	69,970	69,282	70,392	71,220	72,149	71,360	76.8	76.1	75.3	75.3	76.3	76.3	75.0
Women, 16 and older	59,931	61,417	59,886	61,206	61,995	61,936	60,944	61.2	60.3	58.9	59.8	60.6	60.1	58.9
White	109,292	112,393	110,086	111,686	113,300	113,883	111,950	68.8	68.1	66.8	67.5	68.5	68.3	67.1
Men	58,871	60,757	59,894	60,471	61,226	61,953	61,146	77.7	77.0	75.8	75.9	76.9	76.9	75.7
16 and 17 years	1,742	1,638	1,374	1,451	1,462	1,433	1,429	63.0	58.9	49.3	51.1	51.5	50.0	47.7
18 and 19 years	1,973	2,001	1,904	1,899	1,883	1,887	1,998	80.8	80.4	75.6	73.5	72.6	71.3	69.9
20 to 24 years	5,527	5,632	5,773	5,760	5,730	5,873	6,096	89.0	87.3	89.5	88.8	88.2	87.2	85.1
25 to 29 years	6,553	6,997	7,074	7,016	7,026	7,251	7,224	93.9	93.9	94.9	94.2	94.8	94.5	93.6
30 to 34 years	7,884	8,327	8,390	8,539	8,521	8,676	8,445	94.9	95.1	95.6	95.5	95.5	95.4	94.5
35 to 39 years	8,187	8,768	8,635	8,720	8,774	8,834	8,587	95.3	96.7	95.3	94.9	95.5	95.3	93.7
40 to 44 years	7,750	7,949	7,880	7,934	7,951	7,949	7,827	95.8	95.6	94.7	94.5	94.9	94.3	93.2
45 to 49 years	6,685	7,052	6,920	6,886	6,897	6,859	6,740	92.4	94.5	92.7	93.3	93.5	92.7	91.8
50 to 54 years	5,197	5,139	5,163	5,150	5,155	5,211	4,991	89.6	89.0	89.3	89.0	89.1	89.9	87.8
55 to 59 years	3,613	3,592	3,605	3,570	3,694	3,739	3,589	79.2	78.4	78.7	77.4	80.1	80.9	78.6
60 to 64 years	2,191	2,059	1,873	2,102	2,258	2,285	2,220	54.8	50.8	46.3	51.2	55.0	55.6	54.3
65 to 69 years	817	841	647	810	1,028	1,085	1,074	21.5	21.8	16.8	20.4	25.9	27.3	27.4
70 years and older	752	762	656	634	847	871	,926	10.8	9.7	8.3	8.0	10.7	11.0	11.7
Women	50,421	51,636	50,192	51,215	52,074	51,930	50,804	60.7	60.0	58.4	59.7	60.7	60.2	59.0
16 and 17 years	1,663	1,406	1,201	1,420	1,409	1,326	1,320	62.5	52.6	44.9	52.4	52.0	48.5	46.7
18 and 19 years	2,051	1,912	1,668	1,839	1,856	1,756	1,798	81.2	74.4	64.8	69.9	70.5	66.0	64.5
20 to 24 years	5,739	5,707	5,306	5,381	5,399	5,269	5,170	87.8	84.9	79.0	78.6	78.8	75.6	72.3
25 to 29 years	6,419	6,215	6,136	6,066	6,096	6,010	5,890	89.4	82.7	81.7	79.9	80.3	77.7	75.9
30 to 34 years	6,625	7,150	7,166	7,157	7,065	6,906	6,766	78.1	81.1	81.4	80.2	79.2	76.6	75.7
35 to 39 years	7,377	7,511	7,439	7,468	7,475	7,334	7,024	83.1	82.0	81.2	81.4	81.5	79.6	76.5
40 to 44 years	6,669	7,032	6,679	6,832	6,916	6,926	6,674	80.5	83.5	79.3	80.9	81.9	81.8	78.8
45 to 49 years	5,206	5,449	5,646	5,833	5,931	6,026	5,856	69.9	71.4	74.0	77.5	78.8	79.9	78.2
50 to 54 years	3,756	4,076	4,024	4,027	4,189	4,294	4,218	61.9	67.5	66.7	66.9	69.6	71.2	71.5
55 to 59 years	2,420	2,562	2,525	2,646	2,854	2,927	2,908	50.0	51.9	51.3	53.6	57.8	59.2	60.0
60 to 64 years	1,459	1,442	1,460	1,521	1,608	1,753	1,714	33.3	31.7	32.2	33.5	35.4	38.6	38.2
65 to 69 years	619	686	563	598	753	861	837	13.4	14.7	12.1	12.8	16.1	18.4	18.1
70 years and older	418	488	379	427	523	542	629	3.8	4.0	3.1	3.6	4.4	4.6	5.4
Black and other	18,250	18,994	19,082	19,912	19,915	20,202	20,354	67.0	65.7	65.9	65.7	65.8	65.5	64.3
Men	8,740	9,213	9,388	9,921	9,994	10,196	10,215	71.3	70.6	71.7	71.8	72.5	72.4	70.7
16 and 17 years	159	152	171	242	250	242	239	24.8	24.7	27.7	33.2	34.2	32.7	29.9
18 and 19 years	270	252	301	385	363	365	370	48.8	46.7	54.5	59.6	56.0	55.0	51.8
20 to 24 years	970	898	1,017	1,144	1,107	1,185	1,243	70.8	68.3	76.6	78.0	75.5	77.7	74.3
25 to 29 years	1,174	1,265	1,265	1,308	1,318	1,375	1,428	88.1	84.1	84.2	87.6	88.6	88.8	86.9
30 to 34 years	1,418	1,516	1,518	1,523	1,524	1,578	1,573	94.6	87.6	87.2	89.3	90.0	90.1	88.2
35 to 39 years	1,247	1,485	1,468	1,482	1,480	1,486	1,497	91.6	90.8	89.5	90.9	91.2	89.6	85.0
40 to 44 years	1,113	1,244	1,249	1,258	1,238	1,266	1,277	93.1	90.1	90.3	90.1	88.7	89.5	86.8
45 to 49 years	878	935	975	967	983	980	932	88.2	84.2	87.3	87.1	88.6	87.3	82.5
50 to 54 years	672	681	663	705	708	709	759	83.6	84.3	81.7	81.9	82.1	81.5	79.6
55 to 59 years	412	414	412	521	525	511	427	65.9	64.8	64.4	71.6	72.1	69.5	66.4
60 to 64 years	263	246	229	245	304	298	268	47.8	48.2	44.8	40.3	50.0	48.5	47.9
65 to 69 years	96	68	71	96	122	118	124	18.5	15.6	16.5	17.6	22.3	21.4	26.0
70 years and older	68	57	49	45	72	83	77	8.3	6.9	6.0	5.1	8.1	9.3	9.2

Table 1. The 1995 labor force, and labor force participation rates, actual and as projected in 1980, 1983, 1985, 1987, 1989, and 1991—continued

Labor force group	Labor force (in thousands)							Participation rate (in percent)						
	As published in —						Actual	As published in —						Actual
	1980	1983	1985	1987	1989	1991	1995	1980	1983	1985	1987	1989	1991	1995
Women	9,510	9,781	9,694	9,991	9,921	10,006	10,140	63.5	61.7	61.1	60.5	60.1	59.7	58.9
16 and 17 years	245	175	167	234	231	223	237	38.8	28.4	27.0	32.9	32.4	30.9	30.1
18 and 19 years	300	268	271	356	361	344	374	49.6	45.0	45.5	52.5	53.2	49.9	50.2
20 to 24 years	1,207	1,089	1,010	1,147	1,106	1,136	1,179	75.4	69.8	64.5	67.6	65.2	65.4	62.7
25 to 29 years	1,373	1,367	1,304	1,288	1,268	1,297	1,369	85.3	80.1	76.5	73.1	72.0	71.6	70.7
30 to 34 years	1,554	1,568	1,562	1,510	1,506	1,492	1,502	86.7	82.0	81.5	77.0	76.9	74.3	72.2
35 to 39 years	1,435	1,523	1,513	1,536	1,532	1,489	1,545	83.7	82.5	81.9	81.2	81.1	77.6	74.7
40 to 44 years	1,170	1,361	1,312	1,313	1,318	1,341	1,320	77.5	83.9	80.9	79.6	79.9	80.5	76.2
45 to 49 years	853	941	1,044	1,018	1,004	1,008	997	70.6	70.5	78.0	75.9	74.8	74.4	73.5
50 to 54 years	584	659	694	711	695	742	731	60.3	65.7	69.1	67.5	65.9	69.7	65.5
55 to 59 years	379	423	449	487	480	477	485	50.4	51.6	54.7	55.7	54.9	54.0	59.1
60 to 64 years	244	244	261	261	243	258	249	36.5	34.6	36.8	34.6	32.2	33.7	34.3
65 to 69 years	112	122	75	74	117	122	82	16.2	18.8	11.6	10.5	16.5	17.0	12.3
70 years and older	54	41	32	56	60	77	70	4.4	2.8	2.2	3.5	4.2	5.4	5.4
Black	—	—	14,796	15,058	15,120	15,102	14,817	—	—	65.3	65.6	65.9	65.3	63.7
Asian and other	—	—	—	4,854	4,795	5,100	5,539	—	—	—	65.8	65.3	66.1	65.8
Hispanic	—	—	—	11,787	11,939	11,900	12,267	—	—	—	66.7	68.7	68.5	65.8

Note: Dash indicates data not available

Table 2. Characteristics of the 1995 labor force, actual and as projected using the participation rates projected in 1980, 1983, 1985, 1987, 1989, and 1991, with the actual 1995 population and associated errors

Labor force group	Labor force (in thousands)												
	Using rates published in –						Actual	Errors due to participation rate projections[1]					
	1980	1983	1985	1987	1989	1991	1995	1980	1983	1985	1987	1989	1991
Total	143,975	142,311	139,175	140,526	142,276	141,228	132,305	11,671	10,007	6,871	8,222	9,972	8,924
Men, 16 and older	75,833	75,197	74,293	74,759	75,566	75,367	71,361	4,472	3,836	2,933	3,398	4,206	4,007
Women, 16 and older	68,143	67,114	64,882	65,768	66,709	65,860	60,944	7,199	6,171	3,939	4,824	5,766	4,917
White	122,129	121,203	117,980	119,061	120,807	119,956	111,950	10,179	9,253	6,031	7,111	8,857	8,006
Men	65,340	65,089	63,908	64,082	64,855	64,703	61,146	4,193	3,943	2,762	2,936	3,709	3,557
16 and 17 years	2,327	2,306	2,270	2,273	2,303	2,303	1,429	898	877	841	844	874	874
18 and 19 years	1,801	1,684	1,409	1,461	1,472	1,430	1,998	-196	-314	-588	-537	-525	-568
20 to 24 years	5,788	5,759	5,415	5,265	5,200	5,107	6,096	-308	-337	-681	-831	-896	-989
25 to 29 years	6,872	6,740	6,910	6,856	6,810	6,733	7,224	-353	-484	-314	-368	-414	-492
30 to 34 years	8,387	8,387	8,476	8,414	8,468	8,441	8,445	-58	-58	32	-31	23	-4
35 to 39 years	8,699	8,718	8,764	8,754	8,754	8,745	8,587	112	131	176	167	167	158
40 to 44 years	8,005	8,123	8,005	7,972	8,022	8,005	7,827	178	296	178	145	195	178
45 to 49 years	7,037	7,022	6,956	6,941	6,970	6,926	6,740	297	282	216	201	231	187
50 to 54 years	5,251	5,370	5,268	5,302	5,314	5,268	4,991	261	380	278	312	323	278
55 to 59 years	4,090	4,063	4,077	4,063	4,067	4,104	3,589	501	474	488	474	478	515
60 to 64 years	3,237	3,204	3,216	3,163	3,274	3,306	2,220	1,017	984	996	943	1,054	1,086
65 to 69 years	2,148	1,991	1,814	2,007	2,155	2,179	1,074	1,073	917	740	932	1,081	1,105
70 years and older	1,698	1,721	1,327	1,611	2,045	2,156	,926	772	795	401	685	1,119	1,230
Women	56,789	56,114	54,072	54,979	55,952	55,253	50,804	5,986	5,310	3,268	4,175	5,148	4,449
16 and 17 years	1,716	1,696	1,651	1,688	1,716	1,702	1,320	396	376	331	368	396	382
18 and 19 years	1,742	1,466	1,251	1,460	1,449	1,352	1,798	-56	-332	-547	-338	-349	-447
20 to 24 years	5,806	5,319	4,633	4,998	5,041	4,719	5,170	636	149	-537	-172	-129	-451
25 to 29 years	6,814	6,589	6,131	6,100	6,116	5,867	5,890	925	700	242	211	226	-22
30 to 34 years	7,993	7,394	7,305	7,144	7,180	6,947	6,766	1,227	628	538	377	413	181
35 to 39 years	7,174	7,450	7,477	7,367	7,275	7,036	7,024	151	426	454	344	252	13
40 to 44 years	7,037	6,944	6,876	6,893	6,901	6,741	6,674	363	270	202	219	228	67
45 to 49 years	6,029	6,253	5,939	6,059	6,133	6,126	5,856	173	397	83	203	278	270
50 to 54 years	4,125	4,213	4,367	4,573	4,650	4,715	4,218	-93	-4	149	356	432	497
55 to 59 years	2,999	3,270	3,232	3,241	3,372	3,450	2,908	91	362	323	333	464	541
60 to 64 years	2,244	2,329	2,302	2,406	2,594	2,657	1,714	530	615	588	692	880	943
65 to 69 years	1,542	1,468	1,491	1,551	1,639	1,788	837	705	631	654	714	802	951
70 years and older	1,569	1,721	1,417	1,498	1,885	2,154	629	939	1,092	787	869	1,256	1,525
Black and other	21,846	21,109	21,195	21,466	21,469	21,272	20,354	1,492	754	841	1,111	1,114	917
Men	10,493	10,108	10,385	10,677	10,711	10,664	10,215	278	-107	170	462	496	450
16 and 17 years	570	564	573	574	579	579	239	331	325	334	335	340	340
18 and 19 years	177	176	198	237	244	233	370	-193	-194	-172	-133	-126	-137
20 to 24 years	816	781	911	997	936	920	1,243	-427	-462	-332	-246	-306	-323
25 to 29 years	1,163	1,122	1,259	1,282	1,241	1,277	1,428	-265	-306	-170	-147	-188	-152
30 to 34 years	1,571	1,499	1,501	1,562	1,580	1,583	1,573	-2	-73	-71	-11	7	11
35 to 39 years	1,666	1,543	1,536	1,573	1,585	1,587	1,497	169	46	39	76	88	90
40 to 44 years	1,348	1,336	1,317	1,338	1,342	1,319	1,277	71	59	40	60	65	41
45 to 49 years	1,052	1,018	1,020	1,018	1,002	1,011	,932	120	86	88	86	70	79
50 to 54 years	840	802	832	830	844	832	759	82	44	73	71	86	73
55 to 59 years	537	542	525	526	528	524	427	110	115	98	100	101	97
60 to 64 years	369	363	361	401	404	389	268	101	95	93	133	136	121
65 to 69 years	228	230	213	192	238	231	124	104	106	90	68	114	107
70 years and older	155	131	138	148	187	180	77	78	54	61	70	110	102

Table 2. **Characteristics of the 1995 labor force, actual and as projected using the participation rates projected in 1980, 1983, 1985, 1987, 1989, and 1991, with the actual 1995 population and associated errors—continued**

Labor force group	Labor force (in thousands)												
	Using rates published in –						Actual	Errors due to participation rate projections[1]					
	1980	1983	1985	1987	1989	1991	1995	1980	1983	1985	1987	1989	1991
Women	11,353	11,001	10,810	10,789	10,758	10,607	10,140	1,213	861	670	649	618	468
16 and 17 years	499	485	480	476	472	469	237	262	248	243	239	236	232
18 and 19 years	289	211	201	245	241	230	374	-85	-163	-173	-129	-133	-144
20 to 24 years	932	846	855	987	1000	938	1,179	-247	-333	-324	-192	-179	-241
25 to 29 years	1,460	1,352	1,249	1,309	1,263	1,267	1,369	91	-18	-120	-60	-107	-103
30 to 34 years	1,775	1,666	1,592	1,521	1,498	1,490	1,502	272	164	89	19	-4	-13
35 to 39 years	1,793	1,696	1,686	1,593	1,591	1,537	1,545	248	151	141	48	46	-8
40 to 44 years	1,449	1,428	1,418	1,406	1,404	1,344	1,320	129	108	98	86	84	24
45 to 49 years	1,051	1,138	1,097	1,080	1,084	1,092	,997	54	141	100	82	87	95
50 to 54 years	788	787	870	847	835	830	731	57	56	140	116	104	99
55 to 59 years	495	539	567	554	541	572	485	10	54	82	69	56	87
60 to 64 years	366	374	397	404	398	392	249	117	125	148	155	149	143
65 to 69 years	244	231	246	231	215	225	82	162	149	164	149	133	143
70 years and older	213	247	152	138	217	223	70	142	176	82	67	146	153
Black			15,180	15,249	15,319	15,180	14,817			363	432	502	363
Asian and other				5,537	5,495	5,563	5,539				-1	-43	24
Hispanic				12,426	12,798	12,761	12,267				159	531	494

[1] Difference from actual 1995 values

Table 3. **Difference between the projected and actual labor force, and between the original labor force and one using the actual 1995 population, by characteristic, 1980, 1983, 1985, 1987, 1989, and 1991**

[Numbers in thousands]

Labor force group	Difference between the projected and the actual 1995 labor force based on projections made in ¾						Errors due to population projections[1]					
	1980	1983	1985	1987	1989	1991	1980	1983	1985	1987	1989	1991
Total	-4,762	-917	-3,136	-706	911	1,781	-16,433	-10,924	-10,007	-8,928	-9,061	-7,143
Men, 16 and older	-3,750	-1,391	-2,079	-969	-141	788	-8,222	-5,227	-5,011	-4,367	-4,346	-3,218
Women, 16 and older	-1,013	474	-1,058	263	1,052	993	-8,212	-5,697	-4,996	-4,562	-4,714	-3,924
White	-2,658	443	-1,864	-264	1,350	1,933	-12,837	-8,810	-7,894	-7,375	-7,507	-6,073
Men	-2,275	-389	-1,252	-675	80	807	-6,469	-4,332	-4,014	-3,611	-3,629	-2,750
16 and 17 years	313	209	-55	22	33	4	-585	-668	-896	-822	-841	-870
18 and 19 years	-25	3	-94	-99	-115	-111	172	317	495	438	411	458
20 to 24 years	-569	-464	-323	-336	-366	-223	-261	-127	358	495	530	766
25 to 29 years	-671	-227	-150	-208	-198	27	-319	257	164	160	216	518
30 to 34 years	-561	-118	-55	94	76	231	-503	-60	-86	125	53	235
35 to 39 years	-400	181	48	133	187	247	-512	50	-129	-34	20	89
40 to 44 years	-77	122	53	107	124	122	-255	-174	-125	-38	-71	-56
45 to 49 years	-55	312	180	146	157	119	-352	30	-36	-55	-73	-67
50 to 54 years	206	148	172	159	164	220	-54	-231	-105	-152	-159	-57
55 to 59 years	24	3	16	-19	105	150	-477	-471	-472	-493	-373	-365
60 to 64 years	-29	-161	-347	-118	38	65	-1,046	-1,145	-1,343	-1,061	-1,016	-1,021
65 to 69 years	-257	-233	-427	-264	-46	11	-1,331	-1,150	-1,167	-1,197	-1,127	-1,094
70 years and older	-174	-164	-270	-292	-79	-55	-946	-959	-671	-977	-1,198	-1,285
Women	-383	832	-612	411	1,270	1,126	-6,368	-4,478	-3,880	-3,764	-3,878	-3,323
16 and 17 years	343	86	-119	100	89	6	-53	-290	-450	-268	-307	-376
18 and 19 years	253	114	-130	41	58	-42	309	446	417	379	407	404
20 to 24 years	569	537	136	211	229	99	-67	388	673	383	358	550
25 to 29 years	529	325	246	176	206	120	-395	-374	5	-34	-20	143
30 to 34 years	-141	384	400	391	299	140	-1,368	-244	-139	13	-115	-41
35 to 39 years	353	487	415	444	451	310	203	61	-38	101	200	298
40 to 44 years	-5	358	5	158	242	252	-368	88	-197	-61	15	185
45 to 49 years	-650	-407	-210	-23	75	170	-823	-804	-293	-226	-202	-100
50 to 54 years	-462	-142	-194	-191	-29	76	-369	-137	-343	-546	-461	-421
55 to 59 years	-488	-346	-383	-262	-54	19	-579	-708	-707	-595	-518	-523
60 to 64 years	-255	-272	-254	-193	-106	39	-785	-887	-842	-885	-986	-904
65 to 69 years	-218	-151	-274	-239	-84	24	-923	-782	-928	-953	-886	-927
70 years and older	-211	-141	-250	-202	-106	-87	-1,151	-1,233	-1,038	-1,071	-1,362	-1,612

Table 3. **Difference between the projected and actual labor force, and between the original labor force and one using the actual 1995 population, by characteristic, 1980, 1983, 1985, 1987, 1989, and 1991—continued**

[Numbers in thousands]

Labor force group	Difference between the projected and the actual 1995 labor force based on projections made in ¼						Errors due to population projections[1]					
	1980	1983	1985	1987	1989	1991	1980	1983	1985	1987	1989	1991
Black and other	-2,104	-1,360	-1,272	-442	-439	-152	-3,596	-2,115	-2,113	-1,554	-1,554	-1,070
Men	-1,475	-1,002	-827	-294	-221	-19	-1,753	-895	-997	-756	-717	-468
16 and 17 years	-80	-87	-68	3	11	3	-411	-412	-402	-332	-329	-337
18 and 19 years	-100	-118	-69	15	-7	-5	93	76	103	148	119	132
20 to 24 years	-273	-345	-226	-99	-136	-58	154	117	106	147	171	265
25 to 29 years	-254	-163	-163	-120	-110	-53	11	143	6	26	77	98
30 to 34 years	-155	-57	-55	-50	-49	5	-153	17	17	-39	-56	-5
35 to 39 years	-250	-12	-29	-15	-17	-11	-419	-58	-68	-91	-105	-101
40 to 44 years	-164	-33	-28	-19	-39	-11	-235	-92	-68	-80	-104	-53
45 to 49 years	-54	3	43	35	51	48	-174	-83	-45	-51	-19	-31
50 to 54 years	-87	-78	-96	-54	-51	-50	-168	-121	-169	-125	-136	-123
55 to 59 years	-15	-13	-15	94	98	84	-125	-128	-113	-5	-3	-13
60 to 64 years	-5	-22	-39	-23	36	30	-106	-117	-132	-156	-100	-91
65 to 69 years	-28	-56	-53	-28	-2	-6	-132	-162	-142	-96	-116	-113
70 years and older	-9	-20	-28	-32	-5	6	-87	-74	-89	-103	-115	-97
Women	-630	-359	-446	-149	-219	-134	-1,843	-1,220	-1,116	-798	-837	-601
16 and 17 years	8	-62	-70	-3	-6	-14	-254	-310	-313	-242	-241	-246
18 and 19 years	-74	-106	-103	-18	-13	-30	11	57	70	111	120	114
20 to 24 years	28	-90	-169	-32	-73	-43	275	243	155	160	106	198
25 to 29 years	4	-2	-65	-81	-101	-72	-87	15	55	-21	5	30
30 to 34 years	52	66	60	8	4	-10	-221	-98	-30	-11	8	2
35 to 39 years	-110	-22	-32	-9	-13	-56	-358	-173	-173	-57	-59	-48
40 to 44 years	-150	41	-8	-7	-2	21	-279	-67	-106	-93	-86	-3
45 to 49 years	-144	-56	47	21	7	11	-198	-197	-53	-62	-80	-84
50 to 54 years	-147	-72	-37	-20	-36	11	-204	-128	-176	-136	-140	-88
55 to 59 years	-106	-62	-36	2	-5	-8	-116	-116	-118	-67	-61	-95
60 to 64 years	-5	-5	12	12	-6	9	-122	-130	-136	-143	-155	-134
65 to 69 years	30	40	-7	-8	35	40	-132	-109	-171	-157	-98	-103
70 years and older	-16	-29	-38	-14	-10	7	-159	-206	-120	-82	-157	-146
Black	NA	NA	-21	241	303	285	NA	NA	-384	-191	-199	-78
Asian and other	NA	NA	NA	-685	-744	-439	NA	NA	NA	-683	-700	-463
Hispanic	NA	NA	NA	-480	-328	-367	NA	NA	NA	-639	-859	-861

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Table 4. **Difference between the 1995 labor force and the projections made in 1980, 1983, 1985, 1987, 1989, and 1991**

Labor force group	Percentage point difference						Absolute relative error					
	1980	1983	1985	1987	1989	1991	1980	1983	1985	1987	1989	1991
Total	2.0	1.2	0.0	0.6	1.5	1.2	3.0	1.8	0.0	0.9	2.2	1.8
Men, 16 and older	1.8	1.1	0.3	0.3	1.3	1.3	2.4	1.5	0.4	0.4	1.8	
Women, 16 and older	2.3	1.4	0.0	0.9	1.7	1.2	3.8	2.3	0.1	1.5	2.8	2.0
White	1.7	1.0	-0.3	0.4	1.4	1.2	2.6	1.5	0.4	0.6	2.1	1.8
Men	2.0	1.3	0.1	0.2	1.2	1.2	2.6	1.7	0.1	0.2	1.5	1.5
16 and 17 years	15.3	11.2	1.6	3.4	3.8	2.3	32.0	23.4	3.3	7.1	7.9	4.8
18 and 19 years	10.9	10.5	5.7	3.6	2.7	1.4	15.6	15.1	8.2	5.2	3.9	2.0
20 to 24 years	3.9	2.2	4.4	3.7	3.1	2.1	4.6	2.6	5.2	4.3	3.6	2.5
25 to 29 years	0.3	0.3	1.3	0.6	1.2	0.9	0.4	0.4	1.4	0.7	1.3	1.0
30 to 34 years	0.4	0.6	1.1	1.0	1.0	0.9	0.4	0.6	1.1	1.0	1.0	0.9
35 to 39 years	1.6	3.0	1.6	1.2	1.8	1.6	1.7	3.2	1.7	1.3	1.9	1.7
40 to 44 years	2.6	2.4	1.5	1.3	1.7	1.1	2.8	2.6	1.6	1.4	1.8	1.2
45 to 49 years	0.6	2.7	0.9	1.5	1.7	0.9	0.7	3.0	1.0	1.7	1.9	1.0
50 to 54 years	1.8	1.2	1.5	1.2	1.3	2.1	2.0	1.3	1.7	1.3	1.5	2.4
55 to 59 years	0.6	-0.2	0.1	-1.2	1.5	2.3	0.7	0.3	0.1	1.6	1.9	2.9
60 to 64 years	0.5	-3.5	-8.0	-3.1	0.7	1.3	0.9	6.5	14.8	5.7	1.3	2.4
65 to 69 years	-5.9	-5.6	-10.6	-7.0	-1.5	-0.1	21.6	20.5	38.7	25.6	5.5	0.4
70 years and older	-1.0	-2.0	-3.4	-3.7	-1.0	-0.7	8.1	17.4	29.1	31.9	8.8	6.2
Women	1.7	1.0	-0.6	0.7	1.7	1.2	3.0	1.8	0.9	1.3	3.0	2.1
16 and 17 years	15.8	5.9	-1.8	5.7	5.3	1.8	33.9	12.7	3.8	12.2	11.4	3.9
18 and 19 years	16.7	9.9	0.3	5.4	6.0	1.5	25.8	15.3	0.4	8.3	9.3	2.3
20 to 24 years	15.5	12.6	6.7	6.3	6.5	3.3	21.4	17.4	9.3	8.7	9.0	4.6
25 to 29 years	13.5	6.8	5.8	4.0	4.4	1.8	17.8	9.0	7.7	5.3	5.8	2.4
30 to 34 years	2.4	5.4	5.7	4.5	3.5	0.9	3.2	7.2	7.6	6.0	4.7	1.2
35 to 39 years	6.6	5.5	4.7	4.9	5.0	3.1	8.7	7.2	6.2	6.5	6.6	4.1
40 to 44 years	1.7	4.7	0.5	2.1	3.1	3.0	2.1	6.0	0.6	2.7	3.9	3.8
45 to 49 years	-8.3	-6.8	-4.2	-0.7	0.6	1.7	10.6	8.7	5.4	0.9	0.8	2.2
50 to 54 years	-9.6	-4.0	-4.8	-4.6	-1.9	-0.3	13.4	5.6	6.7	6.4	2.6	0.4
55 to 59 years	-10.0	-8.1	-8.7	-6.4	-2.2	-0.8	16.7	13.5	14.5	10.7	3.7	1.4
60 to 64 years	-4.9	-6.5	-6.0	-4.7	-2.8	0.4	12.8	17.0	15.7	12.3	7.3	1.1
65 to 69 years	-4.7	-3.4	-6.0	-5.3	-2.0	0.3	25.9	18.7	33.1	29.2	10.9	1.8
70 years and older	-1.6	-1.4	-2.3	-1.8	-1.0	-0.8	30.0	26.4	42.4	32.7	18.1	14.4

Table 4. Difference between the 1995 labor force and the projections made in 1980, 1983, 1985, 1987, 1989, and 1991—continued

Labor force group	Percentage point difference						Absolute relative error					
	1980	1983	1985	1987	1989	1991	1980	1983	1985	1987	1989	1991
Black and other	2.7	1.4	1.6	1.4	1.5	1.2	4.2	2.2	2.5	2.2	2.4	1.9
Men	0.6	-0.1	1.0	1.1	1.8	1.7	0.8	0.2	1.4	1.5	2.5	2.4
16 and 17 years	-5.1	-5.2	-2.2	3.3	4.3	2.8	17.1	17.4	7.4	11.0	14.3	9.3
18 and 19 years	-3.0	-5.1	2.7	7.8	4.2	3.2	5.8	9.9	5.2	15.0	8.1	6.1
20 to 24 years	-3.5	-6.0	2.3	3.7	1.2	3.4	4.7	8.1	3.1	4.9	1.6	4.5
25 to 29 years	1.2	-2.8	-2.7	0.7	1.7	1.9	1.4	3.2	3.1	0.8	1.9	2.2
30 to 34 years	6.4	-0.6	-1.0	1.1	1.8	1.9	7.3	0.7	1.1	1.2	2.0	2.2
35 to 39 years	6.6	5.8	4.5	5.9	6.2	4.6	7.7	6.8	5.3	6.9	7.3	5.4
40 to 44 years	6.3	3.3	3.5	3.3	1.9	2.7	7.3	3.8	4.0	3.8	2.2	3.1
45 to 49 years	5.7	1.7	4.8	4.6	6.1	4.8	6.9	2.0	5.8	5.6	7.4	5.8
50 to 54 years	4.0	4.7	2.1	2.3	2.5	1.9	5.0	5.9	2.6	2.9	3.1	2.4
55 to 59 years	-0.5	-1.6	-2.0	5.2	5.7	3.1	0.8	2.4	3.0	7.8	8.6	4.6
60 to 64 years	-0.1	0.3	-3.1	-7.6	2.1	0.6	0.1	0.7	6.4	15.8	4.4	1.3
65 to 69 years	-7.5	-10.4	-9.5	-8.4	-3.7	-4.6	28.9	40.0	36.5	32.3	14.2	17.7
70 years and older	-0.9	-2.3	-3.2	-4.1	-1.1	0.1	9.4	24.9	34.7	44.9	12.1	1.0
Women	4.6	2.8	2.2	1.6	1.2	0.8	7.9	4.8	3.8	2.8	2.1	1.4
16 and 17 years	8.7	-1.7	-3.1	2.8	2.3	0.8	28.8	5.7	10.4	9.2	7.6	2.6
18 and 19 years	-0.6	-5.2	-4.7	2.3	3.0	-0.3	1.3	10.4	9.4	4.5	5.9	0.7
20 to 24 years	12.7	7.1	1.8	4.9	2.5	2.7	20.2	11.3	2.8	7.8	3.9	4.3
25 to 29 years	14.6	9.4	5.8	2.4	1.3	0.9	20.6	13.3	8.2	3.4	1.8	1.3
30 to 34 years	14.5	9.8	9.3	4.8	4.7	2.1	20.1	13.6	12.9	6.6	6.5	2.9
35 to 39 years	9.0	7.8	7.2	6.5	6.4	2.9	12.1	10.5	9.7	8.7	8.6	3.9
40 to 44 years	1.3	7.7	4.7	3.4	3.7	4.3	1.7	10.1	6.1	4.4	4.8	5.6
45 to 49 years	-2.9	-3.0	4.5	2.4	1.3	0.9	4.0	4.1	6.1	3.2	1.7	1.2
50 to 54 years	-5.2	0.2	3.6	2.0	0.4	4.2	7.9	0.3	5.5	3.1	0.6	6.4
55 to 59 years	-8.7	-7.5	-4.4	-3.4	-4.2	-5.1	14.7	12.6	7.4	5.7	7.1	8.6
60 to 64 years	2.2	0.3	2.5	0.3	-2.1	-0.6	6.4	0.8	7.2	0.8	6.2	1.8
65 to 69 years	3.9	6.5	-0.7	-1.8	4.2	4.7	32.2	53.4	5.3	14.3	34.7	38.7
70 years and older	-1.0	-2.6	-3.2	-1.8	-1.2	0.0	18.3	48.2	59.6	33.9	21.7	0.7
Median	1.2	0.3	1.0	2.0	1.8	1.7						
Mean absolute percent error							11.6	11.2	10.2	9.4	6.4	4.2

Chart 1. Errors in the participation rate projections to 1995

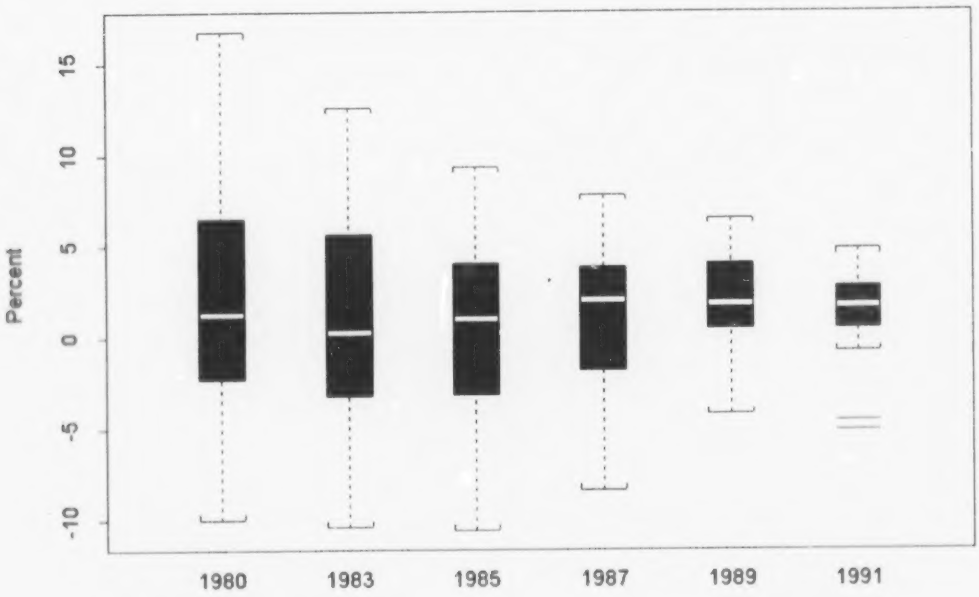
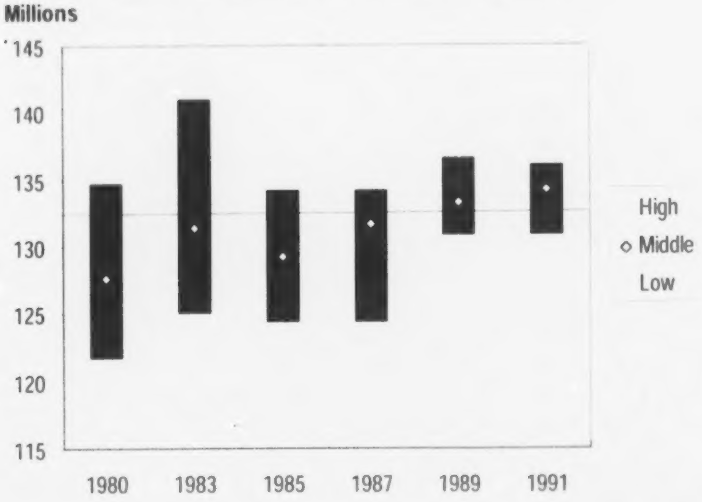


Chart 2. Range of labor force projections to 1995



Industry employment projections,1995: an evaluation

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The Bureau of Labor Statistics' 1984 to 1995 employment projections underestimated the growth of wage and salary employment by 6.5 million employees. Manufacturing employment was over-projected by 2.2 million while employment in the service and government industries was under-projected by 6.8 million. Those major industrial sectors which were projected to have healthy growth rates did so and the sectors projected to have moderate or negative rates actually did grow slowly or declined. Projections of industry employment however showed a much greater deviation from what actually occurred than did the sector employment projections..

Major Industry Sectors

Considering the condition of the economy in 1984 and the economic turmoil of the prior eleven years viz. a viz. inflation, recessions and unemployment, the picture projected for 1995 was uncannily accurate. Fortunately, over the projected period the economy was not impacted by outside shocks approaching those of the preceding eleven years so trends in industry employment were mainly responses to domestic economic forces. Along with those few shocks that did actually occur were some errors within the macro assumptions that netted to an under-projection of jobs. These errors were included an under projection of the labor force of 3 million persons, an unemployment rate projected to be 6% as opposed to the actual 5.6%, productivity projected to grow 20% versus an actual 13% growth and, finally an under projection of total jobs of 8 million. The combination of these sometimes offsetting errors resulted in the Gross Domestic Product (GDP) growth rate to be over project at 38% as opposed to the actual 31%. The following discussion focuses on wage and salary employment as opposed to total employment, total includes wage and salary plus unpaid family and self employed workers. Further, employment in this study refers to a jobs concept as opposed to a person concept which exceeds the percent of the total labor force employed by the amount of multiple job holding by some workers. It is for this reason that the actual employment is a larger percent of the labor force than that projected.

As can be seen, (table 1.), the projected 1995 distribution of employment by sector closely matches the actual distribution. The projected shares of only two sectors, agriculture and wholesale trade, were wrong in direction as compared with 1984. Agriculture employment grew faster than projected because the agricultural services component of this industry showed more vigor than expected. Agriculture still held in 1995 the 1.7% share it had in 1984 rather than dropping to a projected 1.2%. Agriculture is the only sector whose employment was projected to decline but which actually increased. Wholesale trade at a 5.7% share in 1984 was projected to rise to a 5.9% share but actually dropped to 5.3%. More actual growth in the service sectors and less growth in the goods sectors than projected accounted for this discrepancy since service output requires less trade to distribute than does goods output. Wholesale trade is the also only sector whose employment growth was incorrectly projected to be faster than the total employment growth (18.1% as compared to 15.9% for total) but turned out to be slower; the actual rates are 13.6% for wholesale trade and 22.7% for total. Not one sector whose employment was projected to grow slower than total actually grew faster.

Table 1. Projected and actual wage and salaried employment by major industry group: 1984-1995

(Numbers in thousands)

Industry description	Actual	1995				Percent	change	Numeric	Percent	Share of job	total growth
		Projected		Actual		1984	-1995	error	error	1984	-1995
	1984	Level	% share	Level	% share	Projected	Actual	1995	1995	Projected	Actual
Total, all industries[1]	96,843	112,267	100.0	118,833	100.0	15.9	22.7	-6,566	-5.5	100.0	100.0
Agriculture, forestry, and fisheries	1,668	1,401	1.2	1,976	1.7	-16.0	18.4	-575	-29.1	-1.7	1.4
Mining	620	601	.5	418	.4	-3.1	-32.6	183	43.8	-.1	-.3
Construction	4,726	5,225	4.7	5,407	4.5	10.6	14.4	-182	-3.4	3.2	3.1
Manufacturing	19,369	20,683	18.4	18,405	15.5	6.8	-5.0	2,278	12.4	8.5	-4.4
Durables	11,476	12,986	11.6	10,596	8.9	13.2	-7.7	2,390	22.6	9.8	-4.0
Nondurables	7,894	7,697	6.9	7,809	6.6	-2.5	-1.1	-112	-1.4	-1.3	-.4
Transportation, communications, and utilities	5,232	6,031	5.4	6,280	5.3	15.3	20.0	-249	-4.0	5.2	4.8
Wholesale trade	5,568	6,578	5.9	6,324	5.3	18.1	13.6	254	4.0	6.5	3.4
Retail trade, includes eating and drinking places	16,512	19,549	17.4	20,840	17.5	18.4	26.2	-1,291	-6.2	19.7	19.7
Finance, insurance, and real estate	5,683	6,740	6.0	6,949	5.8	18.6	22.3	-209	-3.0	6.9	5.8
Services	21,517	28,468	25.4	33,042	27.8	32.3	53.6	-4,574	-13.8	45.1	52.4
Business and professional services, except medical	8,011	11,728	10.4	13,479	11.3	46.4	68.2	-1,751	-13.0	24.1	24.9
Other services	13,506	16,740	14.9	19,564	16.5	23.9	44.9	-2,824	-14.4	21.0	27.5
Government	15,947	16,991	15.1	19,192	16.2	6.5	20.4	-2,201	-11.5	6.8	14.8

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[1] Employment data for wage and salaried employment are from the BLS Current Employment Statistics (payroll) survey, which counts jobs. Agriculture and private household data are from the Current Population Survey (household survey), which counts workers.

Manufacturing employment was projected to drop from a 20% share to 18.4% but this fell short of the actual decline to 15.5%. Employment in this sector was projected to rise from 1984's level of 19.3 million but instead fell to 18.4 million. These projections were made in 1984 as the economy was emerging from the deepest of two recessions. It was assumed that manufacturing would recover from its recession loses as exports and domestic demand for durable goods increased. This did not occur. Durable goods employment was the only sector projected to be greater in 1995 than in 1984 but which turned out to be lower. The nondurable goods employment level had too great a projected decline while mining's was too little. Construction's employment grew as was projected, but the actual increase was slightly greater. Both the business service sector and the other service sector increased their shares of employment by growing faster than total, as projected, but both did so at a greater rate. Together the employment in the business service sector and the other service sector increased their share of total employment from 22.2% in 1984 to 27.8% in 1995 and except for a slight increase of 0.4% by retail trade these two were the only sectors whose share did not just hold steady or have a decline. The 1984 to1995 percent increase in employment of the business service sector was three times that of the total while that of the other services sector was twice. Government employment fell as a share as projected but the actual drop was much less than projected.

Ultimately it is the satisfaction of GDP that determines industry output and thus its employment. Output is produced either to directly satisfy demand or to be used as an input by other industries whose output is sold to demand. Changes over time to the structure of demand and the production process affect the distribution of industry employment. As one moves down the chain from total demand to demand by major sector to demand by industry the econometric relationships become less stable with more deviation introduced to the projected results. Projections of gross domestic product by major demand sector is the next step in the process of deriving industry outputs (see Table 2.).

Table 2.Demand Components,1984 and 1995, projected and actual:

Annual Average Percent Change

(Constant Dollars)

	Gross National Product	Gross Domestic Product
	1984 to Projected 1995	1984 to Actual 1995
	(1977=100)	(1992=100)
Total	2.9	2.5
Personal Consumption Expenditures	2.8	2.7
Durable Goods	2.8	3.7
Non-durable Goods	1.9	1.9
Services	3.4	2.9
Gross Private Domestic Investment	2.8	1.8
Producers' Durable Equipment	3.8	4.7
Nonresidential Structures	2.0	-1.2
Residential Structures	2.1	1.4
Change in Business Inventories	0.3	-4.0
Net Exports		
Exports	5.6	8.1
Imports	-4.0	-6.3
Government	2.5	2.0
Federal Government	2.8	0.2
National defense	3.4	-0.7
Non-defense	1.1	2.5
State and local Government	2.3	3.3

Changes have been made in the definition and calculation of real demand since the year 1984 such that a comparison of the projected with the actual dollar values of 1995 GDP is difficult. Therefore only relative values will be discussed. A total GDP that was projected to grow at a 2.9% average annual rate only grew 2.5%. This slower growth occurred because the actual higher employment level and lower unemployment rate were offset by a lower growth in productivity. Although few years display a complete lack of destabilizing forces, 1995 could be considered very stabile. Even though it was the fourth year after the last recession the upturn was still not showing signs of major imbalances and a low unemployment rate was accompanied by low inflation and interest rates.

Within total GDP personal consumption expenditures (PCE) is the largest and most stabile sector and its projection was right on. This fortuitous event resulted from some offsetting within PCE. Among the three components of PCE was a correct projection non-durable consumption and an under projection of durable consumption balanced by an over projection of service consumption. The growth rate of gross private domestic investment, the most variable of demand sectors, was over projected due to a too low projection of equipment swamped by a too high projection of construction and inventories. Producer durable equipment demand in 1995 has benefited from the purchases of computer and communications equipment purchases by business which has downsized and sought to increase productivity. Non-residential construction has still not recovered from the tax encouraged over building of the middle eighties; residential construction no longer benefits from the demand it had when the baby boomers were entering the home buying age. Change in business inventories is just that, the increase or decrease in the inventory stock over a year. At end 1995 business' were in the process of working off an excess of inventories and this created the large negative shown.

Trade, both the export and the import components, grew even more vigorously than the smart growth projected. The value of the dollar reached a trade weighted low in 1995 which helped exports despite the tepid growth by the U.S. main trading partners. Import growth reflected the continuing healthy domestic economy as well as imports of unexpectedly cheap oil. Although exports grew faster than imports the U.S. still had a foreign trade deficit because exports started from a lower base than imports. Projected government demand was only slightly higher than actual due to within sector offsets, i.e., defense purchases were much lower while non-defense and State and local purchases were higher than projected. The unexpected ending of the Cold War reversed the defense buildup which had started in the late seventies. Projected cut backs in non-defense spending did not occur. State and local governments continued to increase spending on health and education.

The impact of all this on sector employment results in some surprises. For instance, although projected durable purchases by persons and businesses were too low projected durable manufacturing employment was too high. Defense purchases are heavily weighted towards durable goods so an over projection here counterbalanced the durable demand under projection. Downsizing by manufacturing companies has resulted in the contracting out of many operations that were previously done in house, this outsourcing moves the enumeration of employees performing service functions from the manufacturing sector to the service sector. In addition, although healthy growth in foreign trade was projected, the actual growth was greater still and an larger part than expected of durable demand was satisfied by imports. Inventory change, which primarily consists of manufactured goods, was over projected. The projected employment for the construction sector turned out to be close to actual because an over-projected demand was offset almost exactly by an over-projected productivity increase. Final demand is one outlet for industry output, the other is purchases by other industries to be used as inputs. Since little of the output of the agriculture and metal mining industries, is sold as final demand errors in the projected demand of industries which use them as inputs will affect their projected employment. Mining and a number of manufacturing industries' employment were over-projected as a result of the over-projection of durable goods output. Further, although the personal consumption of services was over projected the employment in the service sector was still under projected because of the unexpected heavy use of contracted services as inputs on the part of manufacturing industries.

When one moves from major sector employment to industry employment the errors in assumptions and in GDP have a more serious impact (table 3). Right off ones sees evidence of what will is a recurrent theme of these projections, agricultural services, as with almost all services, was under projected. Mining employment was over projected partly because it was expected that oil prices would continue to increase to double the $25 per barrel price of 1984 whereas it actually was at $20 in 1995. Higher international oil prices would have made more domestic production profitable while also decreasing imports causing more domestic employment. Coal mining employment was also expected to be helped as cheap domestic coal would be substituted for the more expensive oil and more coal would be exported. Metal mining sells most of its output as inputs to durable manufacturing industries whose output fell.

Of the 122 industries in this study manufacturing represents 75, a 61% share of the industries while its employment share is only 15%. Within this industry scheme not one manufacturing industry had as many as one million jobs. Durable goods encompass 44 industries with employment in 30 of these actually less in 1995 than in 1984 while only 10 were projected to do so. Low employment in those durable goods industries that are defense related such as ordnance, aerospace, ship building and communications equipment reflect the slow down in defense purchases., while an unforeseen surge in imports in the computer industry caused employment to come in at half the projected level. On the other hand, actual employment in nine durable goods industries exceeded the projected level. In one of these, the motor vehicle industry, an increase of U.S. production by foreign companies replaced substituted for both imports and the drop in defense demand. Non-durable manufacturing comprise 31 industries and, although the total sector employment projection was close, the industries themselves show a mixed bag of results. Most of the industries have a small amount of employment and for the large ones the projections were close. The processed food industries did much better than expected. Drugs actually grew at a healthier rate than projected caused the faster than expected growth in the heath service and government health industries. The transportation industries were slightly under projected with the utilities industries over projected, the latter reflecting deregulation. Trade was slightly under projected in the retail area.

When we get to the service industries is hard to chose the brightest star since what could be viewed as very optimistic projections were easily surpassed in reality. The business service industry, admittedly a catch all, increased by 5.4 million or almost 50% over the 1984 level. This industry has been driven in part by temporary help suppliers and reflects the downsizing and cost cutting that has been going on in the rest of the economy. Many firms are replacing permanent employees with temporary ones in order to save on benefit costs and to have more flexibility with their production levels. Further, this industry is where employees will be classified if they supply such services as accounting, marketing, personnel and computer consulting, etc. on a contract basis to firms that previously performed these services in house. Finally, state and local governments added 2.8 million employees, twice what was projected as education and heath output surpassed what was projected. In general, the industries which are the largest and most important in the economy were projected to grow the fastest and this actually occurred. The smaller industries, especially in durable manufacturing did not do as well as projected but these were not projected to have large growth anyway.

An important result of evaluating projections is to highlight the changes, especially the unexpected ones, in the economic structure that have transpired since the projections were made and reflect what these changes mean and how they can be ameliorated.

Table 3. Projected and actual wage and salaried employment by industry: 1984-1995 (Numbers in thousands)

Industry description	Actual 1984	1995				Percent change 1984-1995		Numeric error 1995	Percent error 1995	Share of total job growth 1984 -1995	
		Projected		Actual							
		Level	% share	Level	% share	Projected	Actual			Projected	Actual
Total, all industries	96,843	112,267	100.0	118,833	100.0	15.9	22.7	-6,566	-5.5	100.0	100.0
Agricultural production	1,126	1,021	.9	1,064	.9	-9.3	-5.5	-43	-4.0	-.7	-.3
Agricultural services	501	330	.3	872	.7	-34.2	73.9	-542	-62.2	-1.1	1.7
Forestry, fishing, hunting, and trapping	41	50	.0	40	.0	22.0	-2.4	10	25.0	.1	.0
Metal mining	55	44	.0	51	.0	-20.3	-7.2	-7	-14.1	-.1	.0
Coal mining	196	185	.2	107	.1	-5.4	-45.4	78	73.2	-.1	-.4
Crude petroleum, natural gas, and gas liquids	261	263	.2	155	.1	.8	-40.5	108	69.5	.0	-.5
Nonmetallic minerals, except fuels	109	109	.1	105	.1	.5	-3.5	4	4.1	.0	.0
Construction, including oil and gas svcs	4,726	5,225	4.7	5,407	4.5	10.6	14.4	-182	-3.4	3.2	3.1
Logging	88	78	.1	82	.1	-10.9	-6.7	-4	-4.4	-.1	.0
Sawmills and planing mills	202	190	.2	186	.2	-6.1	-8.2	4	2.3	-.1	-.1
Wood products and mobile homes	428	435	.4	490	.4	1.7	14.5	-55	-11.2	.0	.3
Household furniture	296	321	.3	279	.2	8.6	-5.6	42	15.1	.2	-.1
Misc. furniture and fixtures	191	242	.2	221	.2	27.0	15.8	21	9.6	.3	.1
Glass and glass products	163	167	.1	152	.1	2.5	-6.7	15	9.8	.0	.0
Cement and concrete	223	242	.2	222	.2	8.7	-.4	20	9.1	.1	.0
Stone, clay, and misc. mineral products	176	212	.2	167	.1	20.5	-4.8	45	26.6	.2	.0
Blast furnaces and basic steel products	334	261	.2	239	.2	-21.9	-26.4	22	9.1	-.5	-.4
Foundries, forging, and refining	770	785	.7	721	.6	1.9	-6.4	64	8.9	.1	-.2
Metal cans and shipping containers	59	52	.0	41	.0	-11.3	-29.7	11	26.2	.0	-.1
Cutlery, handtools, and hardware	148	162	.1	131	.1	9.7	-11.0	31	23.3	.1	-.1
Plumbing and nonelectric heating equipment	65	60	.1	60	.1	-8.0	-7.7	0	-.3	.0	.0
Fabricated structural metal products	430	514	.5	428	.4	19.6	-.4	86	20.1	.5	.0
Screw machine products, bolts, rivets, etc	96	108	.1	99	.1	12.1	2.6	9	9.3	.1	.0
Ordnance and ammunition	76	111	.1	51	.0	46.8	-32.8	60	118.5	.2	-.1
Miscellaneous fabricated metal products	342	394	.4	379	.3	15.4	10.8	16	4.1	.3	.2
Engines and turbines	113	124	.1	87	.1	9.7	-22.8	37	42.2	.1	-.1
Farm and garden machinery	108	136	.1	104	.1	26.4	-3.4	32	30.9	.2	.0
Construction and related machinery	257	334	.3	217	.2	29.8	-15.8	117	54.1	.5	-.2
Metalworking machinery and equipment	327	367	.3	340	.3	12.3	3.9	27	8.0	.3	.1
Special industry machinery	158	197	.2	167	.1	24.6	5.6	30	18.0	.3	.0

General industrial machinery and equipment	252	325	.3	253	.2	29.0	.4	72	28.5	.5	.0
Computer and office equipment	515	756	.7	340	.3	46.9	-34.0	416	122.5	1.6	-.8
Refrigeration and service industry machinery	171	194	.2	200	.2	13.3	16.7	-6	-2.9	.1	.1
Industrial machinery nec	317	322	.3	336	.3	1.6	5.9	-14	-4.1	.0	.1
Electric distribution equipment	111	231	.2	81	.1	108.3	-26.9	150	184.8	.8	-.1
Electrical industrial apparatus	201	241	.2	160	.1	19.7	-20.4	81	50.3	.3	-.2
Household appliances	146	150	.1	123	.1	2.6	-16.0	27	22.1	.0	-.1
Electric lighting and wiring equipment	202	223	.2	182	.2	10.5	-9.7	41	22.4	.1	-.1
Household audio and video equipment	90	85	.1	93	.1	-5.6	3.1	-8	-8.4	.0	.0
Communication and scientific equipment	986	1,164	1.0	737	.6	18.1	-25.3	427	58.0	1.2	-1.1
Electronic components and accessories	657	846	.8	582	.5	28.7	-11.5	265	45.5	1.2	-.3
Miscellaneous electrical equipment	170	186	.2	154	.1	9.7	-9.1	32	20.7	.1	-.1
Motor vehicles and equipment	862	826	.7	933	.8	-4.1	8.3	-107	-11.5	-.2	.3
Aerospace	729	866	.8	541	.5	18.8	-25.8	325	60.0	.9	-.9
Ship and boat building and repairing	192	220	.2	163	.1	14.7	-15.3	58	35.4	.2	-.1
Railroad equipment	35	36	.0	38	.0	2.9	8.6	-2	-5.3	.0	.0
Miscellaneous transportation equipment	65	59	.1	70	.1	-9.8	6.7	-11	-15.5	.0	.0
Medical equipment, instruments, & supplies	208	234	.2	262	.2	12.4	25.7	-28	-10.6	-.2	.2
Photographic equipment and supplies	124	135	.1	87	.1	9.0	-30.1	49	56.1	.1	-.2
Watches, clocks and parts	14	14	.0	8	.0	-.7	-43.3	6	75.0	.0	.0
Jewelry, silverware, and plated ware	55	78	.1	51	.0	42.6	-7.3	27	53.8	.2	.0
Manufactured products, nec	327	303	.3	343	.3	-7.3	4.9	-40	-11.6	-.2	.1
Meat products	355	328	.3	465	.4	-7.7	30.8	-137	-29.4	-.2	.5
Dairy products	163	126	.1	150	.1	-22.8	-8.2	-24	-15.9	-.2	-.1
Grain mill products, fats and oils	166	124	.1	159	.1	-25.2	-3.9	-35	-22.2	-.3	.0
Bakery products	218	181	.2	212	.2	-16.9	-2.8	-31	-14.6	-.2	.0
Sugar and confectionery products	102	85	.1	99	.1	-16.5	-2.5	-14	-14.4	-.1	.0
Beverages	214	191	.2	179	.2	-10.9	-16.6	12	6.8	-.2	-.2
Miscellaneous foods and kindred products	390	415	.4	421	.4	6.3	7.9	-6	-1.5	.2	.1
Tobacco products	64	56	.0	39	.0	-12.8	-38.6	17	42.1	-.1	-.1
Weaving, finishing, yarn and thread mills	432	354	.3	350	.3	-18.1	-19.0	4	1.2	-.5	-.4
Knitting mills	208	168	.1	191	.2	-19.0	-7.8	-23	-12.2	-.3	-.1
Carpets and rugs	53	43	.0	65	.1	-19.5	20.8	-22	-33.3	-.1	.1
Miscellaneous textile goods	53	46	.0	51	.0	-13.9	-5.2	-5	-9.1	.0	.0
Apparel	1,000	808	.7	705	.6	-19.2	-29.5	103	14.6	-1.2	-1.3
Miscellaneous fabricated textile products	185	174	.2	211	.2	-5.9	14.3	-37	-17.7	-.1	.1
Paperboard containers and boxes	197	183	.2	215	.2	-7.2	9.0	-32	-14.8	-.1	.1
Pulp, paper, and paperboard	477	480	.4	473	.4	.7	-.8	7	1.5	.0	.0
Newspapers	440	508	.5	453	.4	15.5	3.0	55	12.2	.4	.1
Periodicals, except newspapers	277	313	.3	341	.3	13.2	23.5	-28	-8.3	.2	.3
Printing	659	785	.7	762	.6	19.1	15.6	23	3.1	.8	.5
Industrial chemicals	305	305	.3	272	.2	-.1	-11.0	33	12.3	.0	-.2
Plastics materials and synthetics	178	162	.1	158	.1	-8.9	-11.3	4	2.7	-.1	-.1
Drugs	206	243	.2	260	.2	18.1	26.1	-17	-6.4	.2	.2
Soap, cleaners, and toilet goods	145	160	.1	152	.1	10.0	4.5	8	5.3	.1	.0

Paints and allied products	62	57	.1	58	.0	-8.1	-6.3	-1	-1.9	.0	.0
Agricultural chemicals	61	61	.1	53	.0	.7	-12.2	8	14.7	.0	.0
Miscellaneous chemical products	92	101	.1	93	.1	9.4	.9	8	8.5	.1	.0
Petroleum and coal product manufacturing	189	175	.2	144	.1	-7.4	-24.0	31	21.8	-.1	-.2
Tires and inner tubes	95	86	.1	83	.1	-9.7	-13.1	3	4.0	-.1	-.1
Rubber products, plastic hose and footwear	184	132	.1	184	.2	-28.2	.2	-52	-28.4	-.3	.0
Miscellaneous plastics products, nec	534	707	.6	705	.6	32.4	31.9	2	.3	1.1	.8
Footwear and other leather products	190	140	.1	108	.1	-26.1	-43.0	32	29.5	-.3	-.4
Railroad transportation	376	283	.3	239	.2	-24.7	-36.5	45	18.7	-.6	-.6
Local and interurban passenger transit	270	267	.2	448	.4	-1.2	65.6	-181	-40.3	.0	.8
Trucking and warehousing	1,317	1,571	1.4	1,879	1.6	19.3	42.6	-308	-16.4	1.6	2.6
Water transportation	190	206	.2	160	.1	8.4	-16.1	47	29.2	.1	-.1
Air transportation	488	574	.5	766	.6	17.6	56.8	-192	-25.0	.6	1.3
Pipelines, except natural gas	19	20	.0	17	.0	4.7	-13.6	4	21.2	.0	.0
Miscellaneous transportation services	253	362	.3	424	.4	43.1	67.4	-62	-14.5	.7	.8
Communications	1,340	1,575	1.4	1,358	1.1	17.5	1.3	217	16.0	1.5	.1
Electric utilities	645	827	.7	585	.5	28.3	-9.3	242	41.5	1.2	-.3
Gas utilities	223	225	.2	189	.2	.8	-15.4	36	19.0	.0	-.2
Water and sanitation	110	121	.1	218	.2	10.0	98.5	-97	-44.6	.1	.5
Wholesale trade	5,568	6,578	5.9	6,324	5.3	18.1	13.6	254	4.0	6.5	3.4
Retail trade, exc. eating and drinking places	11,131	12,890	11.5	13,617	11.5	15.8	22.3	-727	-5.3	11.4	11.3
Eating and drinking places	5,381	6,659	5.9	7,223	6.1	23.8	34.2	-564	-7.8	8.3	8.4
Banking and brokerages	2,852	3,396	3.0	3,316	2.8	19.1	16.3	80	2.4	3.5	2.1
Insurance	1,765	2,056	1.8	2,243	1.9	16.5	27.1	-187	-8.3	1.9	2.2
Real estate and royalties	1,067	1,288	1.1	1,390	1.2	20.7	30.3	-102	-7.3	1.4	1.5
Lodging places and residential care	1,532	1,955	1.7	2,259	1.9	27.6	47.5	-304	-13.5	2.7	3.3
Beauty and barber shops	341	430	.4	395	.3	26.3	16.0	35	8.8	.6	.2
Personal and repair services, nec	706	1,160	1.0	881	.7	64.4	24.8	280	31.7	2.9	.8
Advertising	183	227	.2	241	.2	24.0	31.3	-14	-5.6	.3	.3
Misc. business, professional, social svcs	7,828	11,501	10.2	13,238	11.1	46.9	69.1	-1,737	-13.1	23.8	24.6
Automotive services	682	864	.8	1,025	.9	26.6	50.3	-161	-15.7	1.2	1.6
Motion pictures and video tape rental	276	243	.2	586	.5	-11.9	112.6	-343	-58.5	-.2	1.4
Amusement and recreation services, nec	859	1,056	.9	1,474	1.2	23.0	71.7	-418	-28.4	1.3	2.8
Doctors, nursing homes, and misc. health	3,115	4,796	4.3	5,454	4.6	54.0	75.1	-658	-12.1	10.9	10.6
Hospitals	3,004	3,253	2.9	3,816	3.2	8.3	27.0	-563	-14.7	1.6	3.7
Educational, job training, child care, etc	1,755	1,964	1.7	2,712	2.3	11.9	54.5	-748	-27.6	1.4	4.3
Private households	1,238	1,019	.9	963	.8	-17.7	-22.2	56	5.8	-1.4	-1.3
U.S. Postal Service	703	677	.6	843	.7	-3.7	20.0	-166	-19.7	-.2	.6
Federal government enterprises, nec	197	140	.1	194	.2	-29.0	-1.8	-54	-27.6	-.4	.0
General government	14,325	15,429	13.7	17,389	14.6	7.7	21.4	-1,960	-11.3	7.2	13.9
Local government passenger transit	186	209	.2	212	.2	12.4	14.2	-3	-1.6	.1	.1
State and local govt enterprises, nec	536	536	.5	554	.5	.0	3.3	-18	-3.2	.0	.1

EVALUATING THE 1995 OCCUPATIONAL EMPLOYMENT PROJECTIONS

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The Bureau's occupational employment projections captured most general occupational trends over the 1984-95 period. Some of the most glaring inaccuracies in the projections for detailed occupations reflect the conservative nature of projected growth rates that was identified in previous evaluations. Although the impact of inaccurate industry employment projections on the occupational employment projections was significant, the projections of the changes in the utilization of occupations by industry resulted in the biggest source of projection error as in past evaluations.

Major Occupational Groups

The direction of employment change was projected correctly for all nine of the major occupational groups. The absolute projection error was less than 10 percent for eight out of the nine groups, and 11.3 percent for professional specialty occupations, the major occupational group with the largest absolute error. (See table 1.)

Projected employment was lower than actual in six major groups: executive, administrative, and managerial occupations; professional specialty occupations; marketing and sales occupations; administrative support occupations, including clerical; services occupations; and operators, fabricators, and laborers. Employment was overestimated for precision production, craft and repair occupations, and technicians and related support occupations. This latter group was projected the most accurately with projected employment less than 1 percent more than actual employment. The decline in employment was slightly overestimated for agriculture, forestry, fishing and related occupations.

Not only was the direction of employment change anticipated correctly for all the major groups, but the projected distribution of employment growth among the groups was relatively accurate.[1] For example, the professional specialty occupational group had the largest absolute numerical error, nearly 2 million, but the share of total employment growth was under-projected by only 3.4 percent. Thus, the projection for total employment—low by about 7.3 million—had an impact on projection accuracy.

The largest error in the projected share of employment growth was for precision production, craft, and repair occupations. This group's share of total employment growth was over-projected by about 7 percent, in line with employment being over-projected by 886,000. For each major group, however, the same pattern of projection of employment growth and projection of share of employment growth does not apply. In the case of operators, fabricators, and laborers, for example, employment was slightly under-projected but the share of employment growth was over-projected. The projected share of total employment growth was almost exact for marketing and sales workers, although the level of employment was under-projected. (See table 1.)

The fastest growing occupational groups had the largest absolute projection errors. Technicians and related support was projected to be the fastest growing group, but was outpaced by four other groups. The two actual leaders, professional specialty and executive, administrative and managerial occupations, were projected to grow faster than average, but not as fast as they really did grow.

Administrative support workers, including clerical, made up the largest group of workers in 1984 and was also projected to be, even though it did not grow more slowly than average, as projected. The projection error for this group was 8.3 percent. The group's projected slow growth was based on the anticipated effect of the rapid spread of computerized office equipment. As a result, many clerical occupations were correctly projected to grow slowly or decline. However, employment increased more rapidly than projected in several large clerical occupations such as bill and account collectors, adjustment clerks, and teachers aides and educational assistants.

Projection errors were also relatively large for both the service occupations and marketing and sales occupations. Each of these groups grew faster than projected and together they accounted for a combined employment growth of about 8.1 million jobs rather than the expected 5.6 million. More than 60 percent of the projection error of 1.1 million for the marketing and sales occupations can be attributed to an under-projection of two occupations, cashiers and retail salespersons. These occupations accounted for an underestimate of almost 700,000 workers.

Projection errors for agriculture, forestry, fishing, and related occupations, and operators, fabricators, and laborers were relatively small. Part of this accuracy can be attributed to growth among occupations less effected by technological change such as transportation and material moving occupations and nursery workers and animal caretakers, except farm. Conversely, precision production, craft, and repair occupations were over-projected by almost a million workers. Since employment of these workers is concentrated in the construction and manufacturing industries, the projected increase in employment was tied primarily to the projections for those industries.

Professional specialty occupations grew by about 4.7 million over the 1984-1995 period, almost 2 million more than projected. Significant errors in the projections for detailed occupations with sizable employment had a tremendous impact on the overall projection error for this group. For example, an under-projection for five professional specialty occupations–computer systems analysts, engineers, and scientists; college and university faculty, adult and vocational education teachers, registered nurses, and social workers–contributed significantly to the under-projection of professional workers. Under-projection of these occupations accounted for about 38 percent of underestimated employment for this major group. The fact that the projection error for professional specialty occupations was only 11.3 percent, though, can be attributed to some offsetting of this under-projection caused by an over-projection of engineers.[2]

Detailed occupations

The evaluation of the 1995 projections covered 348 detailed occupations. Table 2 presents data on the 207 occupations for which 1984 employment was greater than 50,000, ranked by absolute projection error.[3] The absolute percent errors for all 348 averaged about 24 percent. More than three-fifths of the occupations, however, had below-average errors.

The Bureau can only evaluate the projections for occupations that had comparable definitions in surveys used to compile employment data in the base year and the target year of the projections. Consequently, in past evaluations, relatively few occupations could be evaluated because of classification system changes. However, many more occupations maintained comparability between 1984 and 1995 than in past evaluation periods, because the OES survey occupational classification remained very stable over that period. As a result, the number of occupations included in this evaluation is much larger than in past evaluations.[4]

Projection error is inversely related to employment size, as past projection evaluations have indicated. In 1984, fewer than 100,000 workers were employed in 211 of the 348 occupations included in the evaluation. These 211 had an average· projection error of about 29 percent, whereas 32 occupations with more than 500,000 workers in 1984 had an average error of about 12.2 percent.

The direction of employment change was projected correctly for more than 70 percent of the occupations included in the evaluation. Employment growth was forecast for the majority of the occupations. Of the 231 occupations for which employment actually grew from 1984 to 1995, an increase was projected for all but 16. However, of the 117 occupations for which employment declined, only 37 were projected to decline over the period.

The errors among the occupations included in the evaluation ranged widely. (See table 2.) For example, the difference between projected and actual employment was underestimated by about 42 percent for physicians assistants, but overestimated by about 190 percent for roustabouts. Since roustabouts are primarily concentrated in the oil and gas industry, this projection reveals how the effects of incorrect industry projections can impact the projections for individual occupations.

The last two columns in table 2 present the projected and actual share of the overall employment increase for each of the 207 occupations for which 1984 employment was greater than 50,000. Although there are some notable exceptions, the projected shares for the detailed occupations, like the major groups, are relatively accurate.

Sources of error

Errors in the projections for the detailed occupations included in the evaluation can ultimately be traced back to errors in assumptions or judgment, resulting in incorrectly projected changes in staffing patterns, industry projections, or a combination of both. In order to identify the sources of error, two simulated matrices were created. The first of these was generated by multiplying the projected 1995 staffing patterns of industries by actual 1995 industry employment. The second was produced by multiplying the actual 1995 staffing patterns by projected employment by industry. The first simulation reveals the outcome if the Bureau projected perfect industry employment totals and the second if it had projected perfect occupational staffing patterns. Table 2 presents projection errors from the two simulated matrices created to analyze these effects.

In viewing the projection levels and errors for the detailed occupations, it is possible to identify the effects analytical judgments had on the individual projections. Analyses of underlying trends or impacts of technological change were used in developing both the industry projections and the projected staffing patterns of industries. As mentioned in Arthur Andreassen's contribution to this article, industry employment projections were impacted by unanticipated economic changes.[5] Employment in manufacturing, for example, did not increase as projected, but declined because of a number of factors, including a reduction in defense spending, rapid growth of imports, and a trend towards outsourcing all types of services. In contrast, employment in services grew at a much faster rate than predicted.

The effect of industry errors on the occupational employment may be clearly seen in an example taken from table 2. Earlier, it was mentioned that one of the largest projection errors occurred for roustabouts, around 190 percent. Examining the projection errors from both simulations, shown in table 2, one can see clearly that the error is attributable more to incorrect industry projections for the related oil and gas industries than to the projected staffing pattern: the error in the simulation using actual staffing patterns and projected industry totals is 115 percent while it is only 38 percent with actual industry totals and projected staffing patterns.

Job clusters. In investigating sources of projection error, it is helpful to examine groups of related occupations, or job clusters. A number of such clusters have been selected for closer examination in this section because they show large projection errors or highlight specific sources of error. For example, the under-projection of the education industry affected the projections for education-related occupations. This conclusion is supported by a review of the two simulated matrices for the projection errors for college and university faculty and teachers' aides and educational assistants. Between 1984 and 1995, employment of college and university faculty was projected to decline about 14 percent, though employment actually increased around 12 percent. The projected decline was based primarily on the U.S. Department of Education's National Center for Education Statistics' projected drop in college enrollments reflecting the shrinking population of 18- to 24- year olds. Enrollment rates, however, increased during the 1980s as colleges enrolled greater numbers of older individuals and enrollment rates of students of traditional college age rose more rapidly than expected.

Due to similar misconceptions about enrollments in higher education, employment of adult and vocational education teachers also was significantly under-projected. However, the absolute percent error for adult and vocational education teachers is actually larger in the simulation using the projected staffing patterns and actual 1995 industry totals than in the simulation using actual staffing patterns and projected industry employment. (See table 3.) This indicates that the error in projecting this group of teachers was in fact more the result of the underlying assumptions or judgments that went into determining the utilization of the workers in the education industry, rather than the projection for the education industry. Although moderately rising demand for adult education was anticipated, the declining population of 18-22 year olds was expected to lead to declining demand for vocational education and training. However, the growing number of both entry-level and experienced workers in need of vocational training or retraining in order to update job skills and keep up with rapidly changing technology, had more of an impact on demand for these teachers than was anticipated.

Likewise, errors in projections for select computer-related occupations were a significant contributing factor in the underestimate of employment for professional specialty occupations.[6] A closer examination of the simulated matrices for certain others reveals the cause of error to be largely a result of incorrect assumptions behind the projections of the utilization of these workers by industry. (See table 4.) In the case of computer programmers, very significant increases were projected across all industries as improvements in both computer hardware and software made computer technology more versatile, cheaper, and easier to use. But it was precisely these improvements that led to more moderate growth as computer users, other computer professionals, and automation were able to take over many of the tasks previously performed by only programmers. Similarly, moderate increases were expected for computer operators and operators of peripheral EDP equipment across all industries as computer usage rose throughout the economy. However, expanding technologies not only reduced both the size and cost of computer equipment, but also automated the tasks previously performed by numerous operators.

In contrast to programmers, significant decreases were projected across all industries for data entry keyers, composing, as a result of anticipated technological change. Although the trend was correctly anticipated, it appears that technology had more of an even greater impact on data entry keyers, composing than was projected. Virtually the entire error for this projection can be attributed to incorrect staffing patterns.

Overall industry employment for health services was underestimated significantly for hospitals, as well as doctors, nursing homes, and miscellaneous health services. Absolute errors for health-related occupations ranged from 53 percent for emergency medical technicians to 1 percent for pharmacists. Although the industry projections had a profound impact on estimated employment for these occupations, much of the error in the individual health-related occupations also can be attributed to errors in staffing patterns. (See table 5.) For example, the 1984 projection of a growing demand for physicians' assistants was realized as the health care industry began to focus more and more on cost containment. The Bureau projected the employment of physicians' assistants to increase moderately in hospitals and significantly in outpatient care facilities. However, the projection was too conservative. Similarly, the impact of a growing demand for rehabilitation and long term care services was underestimated, as employment of occupational therapists, projected to grow much faster than average, 36 percent, grew by 159 percent. In the case of licensed practical nurses, the projection was relatively accurate, off only 4 percent, resulting from both the under-projected industry totals for health services and incorrect staffing patterns that offset each other. Along with changes in patient care requirements, the trend toward reliance on nursing personnel with higher levels of clinical skill was expected to slow growth among licensed practical nurses. However, rapid industry growth in health services and an aging population spurred more demand than originally expected in nursing homes and residential care facilities.

The BLS evaluation of industry projections also revealed that employment in manufacturing was projected to increase over the 1984-95 period rather than decline. As a result, the majority of the declining occupations that were projected to increase are in manufacturing—including engineers, precision production workers, machine operators and tenders, and hand workers and fabricators. For example, employment of workers concentrated in industries that manufacture computer and office equipment, electrical industrial apparatus, electronic components and accessories, and aerospace, such as those listed in table 6, was projected to grow slightly when in fact it fell from 1984 to 1995. As indicated in the table, the projected industry totals were the major contributing factor to the error for these occupations.

Implications for future analyses

The most recent occupational projections to be evaluated were those ending in the year 1990. Looking at the major occupational groups, we can readily see that the projections for 1995 appear more accurate overall than do the 1990 projections. No major group was off by more than in the past and the largest absolute error for a major group was only 11.3 percent compared to 22 percent in 1990 for the group—marketing and sales occupations. It is important to remember, however, that projections on such an aggregate scale are by their nature uncertain. Because individual occupations, and not major groups, are analyzed, errors are compounded as these occupations are combined. The detailed occupations that comprise each group can be large enough that any error in their individual projection can affect the outcome for the overall major group.

In developing the detailed 1984-95 occupational projections, analysts reviewed all available data from both the OES survey and Current Population Survey (CPS) and projected changes in the occupation-industry cells accordingly, bringing knowledge gained through experience and studies in preparing the *Occupational Outlook Handbook*. As a result, numerous changes were made to the occupational coefficients—changes affecting the proportion of an occupation within each industry—as analytical judgments were translated into numerical estimates. The bulletin *Employment Projections for 1995: Data and Methods*, indicates that, in order to maintain consistency among the judgments of the analysts, guidelines for increasing or decreasing coefficients were implemented to develop the initial projected coefficients for all occupations across all industries: small change—1 to 4 percent; moderate change—5 to 9 percent; significant change—10 to 20 percent; and very significant change—20 percent or more.[7] The evaluation of the 1984-95 projections has provided analysts the first chance to look back at this work.

Prior to the current evaluation, every BLS evaluation of its occupational projections revealed the projections to be conservative. As the analysis of both the individual projections for detailed occupations and *Handbook* percent-change ranges indicate, the 1984-95 projections are also on the conservative side. The majority of the occupational projections were clustered around average growth, when, in actuality, more appear to have grown much faster than the average or to have declined. The inherent conservatism contributed to overall errors in staffing patterns as well, and part of the reason appears to have been that analysts were too conservative in projecting the matrix coefficients. This trend towards conservatism is recognized by the Bureau and since 1984, guidelines for projecting changes in the occupational coefficients have been revised. For example, when developing the most recent round of projections from 1994-2005, the Bureau set forth the following guidelines for interpreting the projected range of changes in the coefficients: small change—10 percent; moderate—20 percent; significant—35 percent; and very significant—50 percent or more. Expanding the range for identifying small, moderate, and large changes should clearly have an impact on the conservatism inherent in the methodology.

With the help of the simulated matrices prepared for the current evaluation, however, it has been possible to pinpoint the major source of error for each detailed occupation. Although the impact of good industry projections on developing good occupational projections cannot be underestimated, the chief weakness appears to be in projecting the staffing patterns. In the simulated matrix for which the projected staffing patterns were applied to actual 1995 industry totals, the sum of the absolute errors, weighted by 1995 employment, was 7.7 percent. By contrast, in the matrix for which actual 1995 staffing patterns were applied to projected 1995 industry totals, the sum of the absolute errors weighted by 1995 employment dropped to 5.6 percent.

In addition to the influence of conservative coefficient change factors on the projections, the impacts of features such as technological change and trends that were not fully realized contributed significantly to errors in staffing patterns. Incorrect analytical judgments relating to the rate and impact of technological change and to trends such as outsourcing and the growth of temporary help agencies played a large role in this regard. The analysis behind the projection for typists is a case in point. For example, the use of computers and word processing equipment was expected to have a negative impact on employment of typists and word processors across all industries. But because it was assumed that a very large number of establishments were already using such equipment, and because future technological advances in computing technology were not fully realized at the time, the declining trend in employment of typists and word-processors was not expected to accelerate. The analysis wound up underestimating the impact of changing technology, as actual employment in 1995 fell short of projected employment by more than 290 thousand workers.

Similar to unforeseeable events such as the reduction in defense spending resulting from the breakup of the Soviet Union, changes brought about by technology are becoming harder to predict. For example, the impact of Internet Technology is nowhere near being fully realized today, just as the expansion of computer technology into both the home and workplace and the impact of the personal computer, was recognized but not fully accounted for in past projection cycles.

Technical note

Projections framework. The 1984-95 projections of occupational employment were developed within the framework of an industry-occupation matrix containing 378 industries and over 500 occupations. Data used to develop the 1984 matrix and projected 1995 matrix came from a variety of sources. For industries covered by the Occupational Employment Statistics (OES) survey, the most current survey data were used to develop the occupational distribution or staffing patterns for estimating 1984 wage and salary employment. Employment by occupation in each industry were derived by multiplying the occupational distribution of employment by 1984 wage and salary worker employment for each industry, which were obtained from the BLS Current Employment Statistics (CES) survey. Both the CES and OES surveys are surveys of business establishments, covering only wage and salary workers. The 1984 CPS data were used to develop the occupational distribution patterns for workers in agriculture and private households, as well as to develop economy wide estimates of self-employed and unpaid family workers by occupation. Occupational distribution patterns for the Federal Government were developed from data compiled by the Office of Personnel Management. National Center For Education Statistics (NCES) data on teachers were used for these workers as were data from other independent sources for select occupations[8].

The most recent OES survey data available to develop the 1984 matrix came from the following survey years: mining, construction, finance, insurance, real estate, and services, other than hospitals and education, 1991; trade, transportation, communications, public utilities, and State and local governments, 1982; manufacturing industries and hospitals, 1983. The OES survey occupational classification system was revised significantly in 1983 to make it compatible with the newly released Standard Occupational Classification (SOC). As a result, only the 1983 survey of manufacturing and hospitals conformed to the 1983 classification so the 1981 and 1982 data were forced into the new 1983 configuration.[9] However, some occupations were split into more than one occupation or had not been previously identified separately. One of the difficulties in evaluating the 1984-95 set of projections results from the 1984 matrix being constructed with OES survey data collected prior to 1983. The Bureau has developed a national industry-occupation matrix time series covering the 1983-95 period. The series is as consistent as possible with the occupational classification used in the 1994 matrix which was the most current matrix available at the time of development.[10] The actual 1995 employment data used for purposes of this evaluation were taken from that time series. The 1986 matrix, the first matrix in which all of the OES survey data came from surveys conducted after 1983, was used to develop the 1984 data. For this reason, the original 1984-95 published matrix data was not comparable to the actual 1984 and 1995 data published in the historical time series.

In order to reconcile the projected matrix with the historical time series for the purpose of the evaluation, simulated 1984-95 projections were created. To develop these projections, each employment cell coefficient (percent of industry employment accounted for by the occupation) in the 1984 matrix in the historical time series was multiplied by the 1984-95 percent change in that coefficient (change factor) in the original 1984 and 1995 matrices, and the resulting distribution of occupational employment by industry was then benchmarked to the projected industry employment in the original 1995 industry projections. In the resulting simulated projections for most occupations, the projected 1984-95 percent changes remained the same or were very close to the original projections, but the data were defined consistently with the historical time series. Employment of self-employed and unpaid family workers was taken directly from the original published 1984-1995 projections, because the CPS data in 1984 were comparable to the CPS data in 1995, with some minor exceptions. Occupations in the historical matrix that did not appear in the original 1984-95 projections matrix were aggregated into the appropriate residuals; for example, loan interviewers were aggregated into the "all other clerical occupations" residual.

Once the data were prepared, the next task was to select the occupations for evaluation. Occupations were selected only if they met certain criteria. To begin with, all residual occupations were dropped from the evaluation, because occupations for which there were only aggregated data were not necessarily comparable, as indicated in the preceding paragraph. Of the remaining detailed occupations, only those for which the definition remained comparable over the time period were included. Occupations also were dropped if examination of the historical time series indicated inconsistencies with logical expectations for the year to year total employment trend with logical expectations. Because occupations covered in the OES surveys changed over time as improvements in the quality of the survey were made, problems occurred in the development of a comparable time series. In order to make the historical time series as consistent as possible with the 1994 matrix, a number of steps were taken to achieve uniformity over time.[11] For example, occupations appearing in an earlier matrix that were collapsed in the 1994 matrix were also collapsed in the time series. Finally, seven occupations were eliminated because the base year numbers from the original 1984 published matrix were so different from those in the historical 1984 matrix that they did not appear comparable. Consequently, additional occupations were eliminated because the difference in employment between the original 1984 published matrix and the 1984 historical matrix was too large based on specific criteria.[12]

Other data errors. The discussion thus far has focused on errors in individual projections which can be traced back to incorrectly anticipated changes in staffing patterns or incorrect industry projections. Also, comparability problems stemming from inconsistencies in the classification system over time were highlighted. However, it is important to bear in mind that other data problems exist and that differences in actual and projected employment levels are not necessarily due to projection errors. Consequently, real employment trends in an occupation may not necessarily be measured by a comparable survey 10 years apart. And although survey data are generally considered to be fact, sampling and response errors certainly had an impact on the data in both the initial and terminal years of the projection period evaluated.

Footnotes

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[1] In discussing the accuracy of the projected distribution of employment growth among major groups. it is worth addressing a claim made by John H. Bishop in a recent article evaluating the accuracy of BLS projections that "The BLS systematically under-projects the growth of skilled jobs and over-projects the growth of unskilled jobs." (See John H. Bishop. "Is the Market for College Graduates Headed for a Bust? Demand and Supply Responses to Rising College Wage Premiums" *New England Economic Review*. May/June 1996. pp.115-134. quote from p.123.) In his comparison of projected and actual growth for the major occupational groups from 1984 to 1995. Bishop concluded that BLS projected shares of employment growth for professional. technical. and managerial jobs. and operative. laborer. and service jobs were "far off the mark." If we examine theprojected and actual shares of employment growth presented in table 1. however. this does not appear to be the case. Using Current Population Survey (CPS) based data as the "actual" data to compare with the projections rather OES survey-based data which is what is used by BLS in developing the projections. Bishop concluded that from 1984 to 1995. professional. technical. and managerial jobs accounted for 58.3 percent of employment growth and operative. laborer. and service jobs accounted for 15.9 percent. However. OES survey-based data paints a different picture. The problem is that the two data sources are not comparable when one estimates employment growth shares for the major occupational groups. BLS industry-occupation matrix data (see table 1) indicate that professional. technical. and managerial jobs accounted for only 38.5 percent of employment growth from 1984 to 1995. which is much closer to the projected 35.5 percent. Likewise. operative. laborer. and service jobs accounted for 26.3 percent which is only slightly lower than the projected 27.8 percent. (John H. Bishop and Shani Carter. "How accurate are recent BLS occupational projections?" *Monthly Labor Review*. October 1991. pp. 37-43; and John H. Bishop and Shani Carter. "The Worsening Shortage of College-Graduate Workers." *Educational Evaluation and Policy Analysis*. Fall 1991. pp.221-46.)

[2] More details on assumptions leading to the over-projection of engineers are presented in the *Occupational Outlook Quarterly* (Bureau of Labor Statistics. Fall 1997).

[3] Detail on all 348 occupations included in the evaluation is available from the Office of Employment Projections. Data comparing employment. percent changes. and employment growth categories for all 348 occupations included in the evaluation appear in the Fall 1997 *Occupational Outlook Quarterly*.

[4] Only 132 occupations were covered in the evaluation of the 1990 projections. (See Neal H. Rosenthal. "Evaluating the 1990 Projections of Occupational Employment." *Monthly Labor Review*. August 1992. pp. 32-48.)

[5] See page 00.

[6] The detailed professional occupation with the largest under-estimate was computer systems analysts. engineers. and scientists. So as not to lose a group with significant employment change in the evaluation. the three occupations were combined in order to accommodate the change in the occupational classification when computer engineers and the residual. all other computer scientists. were added to the OES survey in 1989. Though it is not classification pure—that is to say. a change occurred with the addition of computer engineers in 1989— the combined group is assumed to account for the same group of workers for which projections were developed in 1984. The OES Survey definition of what computer engineers do is: "Analyze data processing requirements to plan EDP system to provide system capabilities required for projected work loads. Plan layout and installation of new systems or modifications of existing system. May set up and control analog or hybrid computer systems to solve scientific or engineering problems" (*Occupational Employment Statistics Dictionary of Occupations*). Because the title "computer engineer" is often interpreted to denote engineers who design computer hardware. it is likely that some workers in the group were being collected as part of all other engineers or as. electrical and electronics engineers. However. the historical time series does not reveal any tremendous shift in employment when the title was added. indicating computer engineers were already distributed between electrical and electronic engineers and other computer professionals. CPS data reveal a similar trend and there is no separate category for computer engineers.

Some shift in employment away from engineers probably accounts for a portion of the growth in this occupation. Nonetheless. even with the addition of the title "computer engineer." the phenomenal growth of computer-related occupations was underestimated. in large part due to the unanticipated rapid advancement of computing technology. particularly the expansion of personal computers. Over the 1984-95 period. employment of computer systems analysts and scientists was projected to increase 64 percent. making it one of the ten projected fastest growing occupations. However. employment actually increased 181 percent over this period.

[7] See *Employment Projections for 1995: Data and Methods*. Bulletin 2253 (Bureau of Labor Statistics. April 1986).

[8] Prior to 1990. NCES data were used for teachers. preschool and teachers. kindergarten and elementary school. However. in the 1990. 1992. and 1994 matrices. OES survey data for these occupations were used. but the OES classification was different than that used by NCES—teachers. elementary and teachers. preschool and kindergarten. Similar difficulties were encountered with higher education teachers. For these reasons. employment data for the elementary. preschool. and kindergarten teaching occupations were rolled up in the historical time series. but dropped from this evaluation.

[9] A comprehensive methodological statement outlining the data sources and procedures is published in *Employment Projections for 1995: Data and Methods*.

[10] For more information on the methodology used to develop the projections. see the appendix to the series of articles under "Employment Outlook: 1994-2005." *Monthly Labor Review*. November 1995. pp.85-87; and the *BLS Handbook of Methods*. Bulletin 2490 (Bureau of Labor Statistics. April 1997).

[11] For a more comprehensive methodological statement . *The National Industry-Occupation Employment Matrix 1983-1995 Time Series* technical note is available from Office of Employment Projections.

[12] Occupations were dropped if employment for 1984 differed by more than 40.000. but less than 100.000 from the original 1984 level to the actual 1984 level in the historical matrix and the percent difference in 1984 employment was more than 50 percent: and if employment for 1984 differed by more than 100.000 from the original 1984 level to the actual 1984 level in the historical matrix and the percent difference in 1984 employment was more than 30 percent.

Table 1. Employment by major occupational group, 1984 actual and 1995 projected and actual

(Numbers in thousands)

Industry-occupation matrix											
Occupation	Employment					Percent Change 1984-95		Numerical error (projected-actual 1995)	Percent error	Share of total job growth 1984-95	
	Actual 1984	Projected 1995		Actual 1995							
		Level	Percent	Level	Percent	Projected	Actual			Projected	Actual
Total, all occupations	106,729	122,758	100.0	130,009	100.0	15.0	21.8	-7,250	-5.6	100.0	100.0
Executive, administrative, and managerial occupations	9,951	11,933	9.7	13,244	10.2	19.9	33.1	-1,311	-9.9	12.4	14.1
Professional specialty occupations	13,020	15,701	12.8	17,696	13.6	20.6	35.9	-1,995	-11.3	16.7	20.1
Technicians and related support occupations	3,535	4,564	3.7	4,541	3.5	29.1	28.5	23	0.5	6.4	4.3
Marketing and sales workers	10,978	13,322	10.9	14,389	11.1	21.3	31.1	-1,068	-7.4	14.6	14.7
Administrative support occupations, including clerical	19,670	21,731	17.7	23,710	18.2	10.5	20.5	-1,979	-8.3	12.9	17.4
Service occupations	16,244	19,510	15.9	20,889	16.1	20.1	28.6	-1,379	-6.6	20.4	20.0
Agriculture, forestry, fishing, and related occupations	3,798	3,641	3.0	3,779	2.9	-4.1	-0.5	-138	-3.6	-1.0	-0.1
Precision production, craft, and repair occupations	13,469	15,110	12.3	14,224	10.9	12.2	5.6	886	6.2	10.2	3.2
Operators, fabricators, and laborers	16,064	17,246	14.0	17,536	13.5	7.4	9.2	-290	-1.7	7.4	6.3

Table 2. Total employment by occupation, 1984, 1995, and projected 1995

[Numbers in thousands]

Occupation	Total employment					Percent change 1984-95		Numerical error, 1995 (projected actual)	Absolute percent error, 1995	Absolute percent error, 1995		Share of total job growth 1984-95	
	Actual 1984	Projected 1995		Actual 1995									
		Level	Percent share	Level	Percent share	Projected	Actual			Actual industry totals to projected staffing pattern	Actual staffing pattern to projected industry totals	Projected	Actual
Total, all occupations	106,729	122,758	100.00	130,009	100.00	15.0	21.8	-7,250	5.6	0.0	5.6	100.00	100.00
Cooks, institution or cafeteria	361	426	0.35	426	0.33	18.0	18.1	0	0.1	22.4	17.8	0.41	0.28
Aircraft mechanics	82	98	0.08	98	0.08	19.7	19.8	0	0.1	14.6	13.4	0.10	0.07
Mail clerks, except mail machine operators and postal service	126	132	0.11	132	0.10	5.3	5.2	0	0.1	6.5	6.6	0.04	0.03
Blue collar worker supervisors	1,794	1,931	1.57	1,925	1.48	7.6	7.3	6	0.3	1.1	1.7	0.85	0.56
Butchers and meatcutters	229	220	0.18	219	0.17	-4.1	-4.5	1	0.4	13.5	10.9	-0.06	-0.04
Crushing and mixing machine operators and tenders	133	137	0.11	138	0.11	3.5	4.0	-1	0.5	1.0	2.3	0.03	0.02
Highway maintenance workers	159	167	0.14	168	0.13	5.0	5.7	-1	0.5	11.0	12.0	0.05	0.04
Cannery workers	74	72	0.06	72	0.06	-3.4	-2.8	0	0.6	11.1	10.8	-0.02	-0.01
Farmers	1,312	1,240	1.01	1,231	0.95	-5.5	-6.2	9	0.7	8.8	3.8	-0.45	-0.35
Stock clerks	1,707	1,800	1.47	1,815	1.40	5.5	6.3	-15	0.8	2.0	3.2	0.58	0.46
Industrial machinery mechanics	438	465	0.38	470	0.36	6.3	7.3	-5	1.0	5.9	6.8	0.17	0.14
Secretaries	3,050	3,369	2.74	3,403	2.62	10.5	11.6	-34	1.0	4.5	6.0	2.00	1.52
Pharmacists	157	174	0.14	172	0.13	10.7	9.6	2	1.0	2.7	5.5	0.10	0.06
Loan and credit clerks	146	172	0.14	174	0.13	17.5	19.2	-2	1.4	7.7	7.3	0.16	0.12
Bus drivers, except school	138	156	0.13	158	0.12	13.3	14.9	-2	1.4	30.2	24.7	0.11	0.09
Tire repairers and changers	80	90	0.07	91	0.07	12.8	14.5	-1	1.5	4.2	5.8	0.06	0.05
Guards	680	903	0.74	917	0.71	32.8	34.9	-14	1.5	11.1	11.5	1.39	1.02
Brokers, real estate	58	68	0.06	69	0.05	16.2	18.1	-1	1.6	47.3	10.5	0.06	0.05
Police and detective supervisors	80	89	0.07	88	0.07	11.3	9.3	2	1.8	14.9	10.7	0.06	0.03
Purchasing agents, except wholesale, retail, and farm products	183	216	0.18	220	0.17	18.2	20.6	-4	2.0	8.6	9.0	0.21	0.16
Bookkeeping, accounting, and auditing clerks	2,019	2,158	1.76	2,217	1.71	6.9	9.8	-59	2.7	1.0	3.8	0.87	0.85
Order clerks, materials, merchandise, and service	263	315	0.26	324	0.25	19.9	23.3	-9	2.8	4.2	0.6	0.33	0.26
Public relations specialists and publicity writers	83	108	0.09	112	0.09	30.9	34.6	-3	2.8	10.1	11.5	0.16	0.12
Cabinetmakers and bench carpenters	104	124	0.10	127	0.10	18.7	22.1	-4	2.8	2.5	2.7	0.12	0.10
Welders and cutters	291	330	0.27	340	0.26	13.5	16.9	-10	2.8	12.4	10.8	0.25	0.21
Dental assistants	149	191	0.16	197	0.15	28.0	31.9	-6	3.0	9.8	12.1	0.26	0.20
Dispatchers, except police, fire, and ambulance	118	142	0.12	146	0.11	19.7	23.5	-5	3.1	4.4	8.6	0.15	0.12
Waiters and waitresses	1,570	1,978	1.61	1,916	1.47	25.9	22.0	61	3.2	15.2	10.1	2.54	1.49

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Table 2. Total employment by occupation, 1984, 1995, and projected 1995

[Numbers in thousands]

Occupation	Total employment					Percent change 1984-95		Numerical error, 1995 (projected actual)	Absolute percent error, 1995	Absolute percent error, 1995		Share of total job growth 1984-95	
		Projected 1995		Actual 1995									
	Actual 1984	Level	Percent share	Level	Percent share	Projected	Actual			Actual industry totals to projected staffing pattern	Actual staffing pattern to projected industry totals	Projected	Actual
Drywall installers and finishers	117	129	0.11	125	0.10	10.2	6.8	4	3.2	8.6	3.9	0.07	0.03
Pressing machine operators and tenders, textile, garment and related	88	80	0.07	78	0.06	-10.3	-11.1	3	3.2	15.7	15.2	-0.06	-0.05
Stenographers	172	101	0.08	105	0.08	-41.2	-39.2	-3	3.3	3.4	7.8	-0.44	-0.29
Numerical control machine tool operators and tenders, metal/plastic	58	74	0.06	77	0.06	28.3	33.3	-3	3.3	20.9	14.9	0.10	0.08
Pipelayers and pipelaying fitters	53	59	0.05	57	0.04	12.5	8.8	2	3.5	1.6	5.2	0.04	0.02
Food counter, fountain, and related workers	1,377	1,627	1.33	1,692	1.30	18.2	22.9	-65	3.8	6.5	9.9	1.56	1.38
Paralegals	54	105	0.09	110	0.08	94.2	104.2	-4	3.9	20.7	10.5	0.32	0.24
Licensed practical nurses	593	695	0.57	724	0.56	17.3	22.1	-29	4.0	10.8	12.6	0.64	0.56
Machine forming operators and tenders, metal and plastic	174	170	0.14	177	0.14	-2.2	1.7	-7	4.0	11.4	7.2	-0.02	0.01
Bank tellers	497	522	0.43	545	0.42	5.1	9.7	-23	4.2	12.2	8.7	0.16	0.21
Machine builders and other precision machine assemblers	53	65	0.05	61	0.05	22.5	15.6	3	4.3	14.3	20.8	0.07	0.04
Medical assistants	126	204	0.17	214	0.16	62.5	70.6	-10	4.7	8.2	12.4	0.49	0.38
Electricians	511	592	0.48	565	0.43	15.9	10.5	27	4.8	11.6	5.5	0.51	0.23
Truck drivers light and heavy	2,123	2,511	2.05	2,648	2.04	18.3	24.7	-137	5.2	4.1	8.4	2.42	2.26
Photographers	92	121	0.10	115	0.09	31.6	25.1	6	5.2	10.1	3.1	0.18	0.10
Production, planning, and expediting clerks	210	230	0.19	243	0.19	9.4	15.9	-13	5.5	17.9	13.0	0.14	0.14
Packaging and filling machine operators and tenders	298	314	0.26	333	0.26	5.4	11.9	-19	5.8	5.0	2.6	0.10	0.15
Textile draw-out and winding machine operators and tenders	237	199	0.16	188	0.14	-15.9	-20.6	11	5.9	11.0	4.7	-0.24	-0.21
Sewing machine operators, non-garment	137	137	0.11	130	0.10	0.4	-5.2	8	5.9	11.2	2.4	0.00	-0.03
Carpet installers	64	75	0.06	70	0.05	15.8	9.4	4	5.9	20.2	9.2	0.06	0.03
Salespersons, retail	3,284	3,729	3.04	3,970	3.05	13.6	20.9	-241	6.1	1.6	4.6	2.78	2.96
Heat, air conditioning, and refrigeration mechanics and installers	209	247	0.20	233	0.18	18.0	11.1	14	6.2	12.1	5.6	0.23	0.10
Police patrol officers	334	378	0.31	403	0.31	13.1	20.7	-25	6.3	7.0	12.0	0.27	0.30
Janitors and cleaners, including maids/houskeeping cleaners	2,449	2,890	2.35	3,086	2.37	18.0	26.0	-196	6.3	6.7	12.6	2.75	2.74
Extruding and forming machine setters, operators and tenders	104	110	0.09	103	0.08	5.6	-0.8	7	6.4	8.7	1.0	0.04	0.00
Carpenters	940	1,029	0.84	965	0.74	9.5	2.7	64	6.6	12.2	3.8	0.56	0.11
Travel agents	94	138	0.11	129	0.10	46.5	37.3	9	6.7	14.1	9.5	0.27	0.15
Sheet metal workers and duct installers	215	246	0.20	230	0.18	14.3	7.0	16	6.8	2.6	4.5	0.19	0.06

Table 2. Total employment by occupation, 1984, 1995, and projected 1995

[Numbers in thousands]

Occupation	Total employment					Percent change 1984-95		Numerical error, 1995 (projected actual)	Absolute percent error, 1995	Absolute percent error, 1995		Share of total job growth 1984-95	
	Actual 1984	Projected 1995		Actual 1995						Actual industry totals to projected staffing pattern	Actual staffing pattern to projected industry totals		
		Level	Percent share	Level	Percent share	Projected	Actual					Projected	Actual
Employ interviewers, private or public employment service	63	83	0.07	83	0.06	31.5	30.1	6	7.2	23.0	13.3	0.16	0.08
Cost estimators	143	171	0.14	184	0.14	19.2	28.5	-13	7.3	3.3	0.3	0.17	0.18
Central office and PBX installers and repairers	77	86	0.07	80	0.06	11.4	3.8	6	7.3	0.1	17.8	0.05	0.01
Insulation workers	53	60	0.05	65	0.05	12.9	21.9	-5	7.4	4.7	3.4	0.04	0.05
Chemists	84	89	0.07	96	0.07	5.8	14.0	-7	7.4	2.6	11.3	0.03	0.05
Personnel clerks, except payroll and timekeeping	115	135	0.11	125	0.10	16.5	8.2	10	7.7	7.8	[illegible]	0.12	0.04
Helpers, construction trades	466	484	0.39	525	0.40	3.8	12.5	-41	7.8	8.1	3.9	0.11	0.25
Librarians, professional	128	139	0.11	152	0.12	8.5	18.2	-13	8.2	9.5	16.4	0.07	0.10
Chemical equipment controllers, operators and tenders	77	79	0.06	73	0.06	3.1	-5.1	6	8.6	1.4	9.6	0.01	-0.02
Police detectives and investigators	55	62	0.05	66	0.05	13.1	20.8	-4	8.9	0.1	7.5	0.03	0.05
Plastic molding machine operators and tenders, setters and setup operators	142	185	0.15	163	0.13	29.6	18.9	15	9.0	6.7	2.1	0.26	0.12
Registered nurses	1,326	1,758	1.43	1,937	1.49	32.6	46.1	-179	9.2	3.7	12.3	2.70	2.63
Maintenance repairers, general utility	953	1,119	0.96	1,234	1.00	17.4	29.5	-121	9.4	5.5	7.4	1.08	1.27
Physicians	487	600	0.49	548	0.42	23.2	12.6	52	9.4	22.3	9.6	0.73	0.26
Painters and paperhangers, construction and maintenance	368	384	0.31	424	0.33	4.3	15.2	-40	9.5	2.3	5.8	0.10	0.24
Refuse collectors	106	125	0.10	114	0.09	17.9	7.5	12	10.2	46.4	22.8	0.12	0.03
Welfare eligibility workers and interviewers	82	94	0.08	105	0.08	15.0	28.1	-11	10.2	2.2	8.3	0.08	0.10
Concrete and terrazzo finishers	100	117	0.10	130	0.10	17.0	30.4	-13	10.3	2.5	6.3	0.11	0.13
Mobile heavy equipment mechanics	102	119	0.10	108	0.08	16.6	5.6	11	10.4	8.1	3.6	0.11	0.02
New accounts clerks, banking	87	99	0.08	111	0.09	14.4	27.7	-12	10.4	17.7	9.0	0.08	0.10
Data entry keyers, except composing	369	370	0.30	414	0.32	0.4	12.3	-44	10.7	4.6	7.3	0.01	0.20
Institutional cleaning supervisors	108	141	0.12	128	0.10	30.9	18.2	14	10.8	28.8	12.8	0.21	0.08
Taxi drivers and chauffeurs	84	95	0.08	107	0.08	12.9	26.7	-12	10.8	6.0	18.3	0.07	0.10
Sewing machine operators, garment	673	568	0.46	511	0.39	-15.7	-24.1	57	11.1	2.7	9.2	-0.66	-0.70
Payroll and timekeeping clerks	192	182	0.15	163	0.13	-5.6	-15.2	19	11.4	16.9	3.7	-0.07	-0.13
Artists and commercial artists	184	240	0.20	272	0.21	30.2	47.3	-31	11.6	2.7	6.7	0.35	0.37
Combination machine tool setters, setup operators, operators, and tenders	95	122	0.10	109	0.08	28.1	14.8	13	11.6	3.8	11.7	0.17	0.06
Cooks, restaurant	485	630	0.51	714	0.55	29.9	47.0	-83	11.7	4.2	9.4	0.90	0.98
Respiratory therapists	53	64	0.05	73	0.06	20.6	36.6	-9	11.7	0.8	12.2	0.07	0.08

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Table 2. Total employment by occupation, 1984, 1995, and projected 1995

[Numbers in thousands]

Occupation	Total employment					Percent change 1984-95		Numerical error, 1995 (projected actual)	Absolute percent error, 1995	Absolute percent error, 1995		Share of total job growth 1984-95	
	Actual 1984	Projected 1995		Actual 1995						Actual industry totals to projected staffing pattern	Actual staffing pattern to projected industry totals		
		Level	Percent share	Level	Percent share	Projected	Actual					Projected	Actual
Machine feeders and offbearers	278	296	0.24	265	0.20	6.6	-4.7	31	11.8	11.7	0.8	0.11	-0.06
Lawyers	527	722	0.59	645	0.50	37.1	22.4	76	11.8	9.5	1.8	1.22	0.51
Fire fighters	214	247	0.20	220	0.17	15.3	2.8	27	12.1	27.7	12.1	0.20	0.03
Machinists	386	424	0.35	378	0.29	9.7	-2.1	46	12.1	2.4	11.7	0.23	-0.04
Clinical lab technologists and technicians	231	245	0.20	279	0.21	6.0	20.6	-34	12.1	2.3	12.7	0.09	0.21
Aircraft pilots and flight engineers	66	82	0.07	93	0.07	24.0	41.2	-11	12.2	15.5	24.6	0.10	0.12
Hairdressers, hairstylists, and cosmetologists	525	687	0.56	611	0.47	30.8	16.4	75	12.3	13.5	0.2	1.01	0.37
Food preparation workers	879	1,078	0.88	1,210	0.95	22.6	37.7	-152	12.4	0.0	11.9	1.24	1.51
Home appliance and power tool repairers	75	86	0.07	77	0.06	15.2	2.3	10	12.6	16.2	0.0	0.07	0.01
Child care workers, private household	401	347	0.28	308	0.24	-13.5	-23.2	39	12.7	6.4	5.9	-0.34	-0.46
Cutting and slicing machine setters, operators and tenders	82	81	0.07	94	0.07	-2.7	14.4	-12	13.2	10.9	1.9	0.00	0.05
Bus drivers, school	311	364	0.30	420	0.32	17.2	35.0	-55	13.2	14.6	23.9	0.33	0.47
Writers and editors, including technical writers	194	246	0.20	284	0.22	26.9	46.5	-38	13.4	6.9	1.0	0.34	0.39
Library assistants and bookmobile drivers	97	107	0.09	123	0.09	9.7	26.6	-16	13.4	2.6	10.4	0.06	0.11
Insurance sales workers	425	474	0.39	415	0.32	11.4	-2.6	59	14.2	22.5	8.1	0.30	-0.05
Wholesale and retail buyers, except farm products	189	214	0.17	187	0.14	13.2	-1.2	27	14.6	18.2	1.5	0.16	-0.01
Cashiers	2,016	2,627	2.14	3,080	2.37	30.3	52.8	-453	14.7	8.8	7.1	3.81	4.57
Insurance adjusters, examiners, and investigators	109	138	0.11	162	0.12	26.7	48.3	-24	14.9	10.1	3.7	0.18	0.23
Science and mathematics technicians	233	268	0.22	233	0.18	15.1	0.1	35	15.2	20.3	8.3	0.22	0.00
Automotive body and related repairers	202	243	0.20	210	0.16	19.9	3.9	32	15.4	24.4	5.9	0.25	0.03
Bricklayers and stone masons	154	170	0.14	148	0.11	10.6	-4.2	23	15.4	20.7	3.3	0.10	-0.03
Cleaners and servants, private household	532	409	0.33	484	0.37	-23.1	-9.1	-75	15.4	20.1	5.9	-0.77	-0.21
Personnel, training, and labor relations specialists	221	262	0.21	310	0.24	18.5	40.2	-48	15.5	15.5	0.7	0.26	0.38
Underwriters	90	112	0.09	97	0.07	24.1	7.4	15	15.6	13.4	1.3	0.14	0.01
Woodworking machine operators and tenders, setters and setup operators	72	77	0.06	67	0.05	6.7	-7.8	10	15.7	15.9	0.8	0.03	-0.02
Inspectors and compliance officers, except construction	120	133	0.11	158	0.12	10.9	32.2	-26	16.1	11.3	5.1	0.08	0.17
Machine assemblers	51	61	0.05	53	0.04	19.8	2.9	9	16.4	2.4	21.7	0.06	0.01
Hotel desk clerks	97	115	0.09	137	0.11	18.3	41.6	-23	16.5	8.6	8.1	0.11	0.17
Drafters	326	367	0.30	315	0.24	12.7	-3.5	51	16.6	7.4	10.9	0.26	-0.06
Plumbers, pipefitters, and steamfitters	384	442	0.36	378	0.29	14.9	-1.7	64	16.9	21.7	3.6	0.36	-0.03

Table 2. Total employment by occupation, 1984, 1995, and projected 1995

[Numbers in thousands]

Occupation	Total employment					Percent change 1984-95		Numerical error, 1995 (projected actual)	Absolute percent error, 1995	Absolute percent error, 1995		Share of total job growth 1984-95	
		Projected 1995		Actual 1995									
	Actual 1984	Level	Percent share	Level	Percent share	Projected	Actual			Actual industry totals to projected staffing pattern	Actual staffing pattern to projected industry totals	Projected	Actual
Farm managers	164	180	0.15	154	0.12	9.8	-6.1	26	17.0	17.9	0.8	0.10	-0.04
Gardeners and groundskeepers, except farm	597	639	0.52	545	0.42	7.0	-8.8	94	17.2	36.2	14.1	0.26	-0.22
Physical therapists	59	86	0.07	104	0.08	45.3	76.6	-19	17.8	6.6	12.2	0.17	0.19
Designers	198	252	0.21	307	0.24	27.7	55.5	-55	17.9	4.9	4.3	0.34	0.47
Brokerage clerks	51	60	0.05	73	0.06	18.0	43.7	-13	17.9	11.2	6.4	0.06	0.10
Automotive mechanics	706	859	0.70	728	0.56	21.6	3.1	131	17.9	28.9	7.9	0.95	0.09
Dental hygienists	83	107	0.09	130	0.10	28.7	56.9	-23	18.0	6.5	12.2	0.15	0.20
Bus and truck mechanics and diesel engine specialists	256	309	0.25	262	0.20	20.4	2.0	47	18.1	28.0	7.4	0.33	0.02
Water and liquid waste treatment plant and systems operators	71	79	0.06	97	0.07	11.6	36.8	-18	18.4	5.2	13.8	0.05	0.11
Inspectors, testers, and graders, precision	701	791	0.64	668	0.51	13.0	-4.6	123	18.4	5.2	9.0	0.57	-0.14
Driver/sales workers	253	276	0.23	339	0.26	9.2	33.9	-63	18.5	15.6	6.9	0.15	0.37
Cooks, short order and fast food	543	637	0.52	785	0.60	17.3	44.6	-148	18.9	9.3	9.4	0.58	1.04
Order fillers, wholesale and retail sales	188	182	0.15	225	0.17	-3.1	19.6	-43	19.0	18.1	0.8	-0.04	0.16
Roofers	137	156	0.13	131	0.10	13.5	-4.6	25	19.0	24.7	3.4	0.12	-0.03
Counselors	116	135	0.11	168	0.13	16.0	44.8	-34	19.9	1.9	17.3	0.12	0.22
Office machine and cash register servicers	53	70	0.06	58	0.04	31.8	9.9	12	19.9	18.8	4.5	0.11	0.02
Laundry and drycleaning machine operators and tenders, except pressing	130	145	0.12	182	0.14	11.5	39.2	36	19.9	5.0	14.9	0.09	0.22
Millwrights	87	94	0.08	78	0.06	7.0	-10.9	16	20.0	15.1	3.6	0.04	-0.04
Customer service representatives, utilities	104	122	0.10	152	0.12	16.7	45.9	-31	20.0	31.5	16.5	0.11	0.21
Industrial truck and tractor operators	426	381	0.31	477	0.37	-10.6	11.8	-96	20.1	18.4	2.7	-0.28	0.22
Upholsterers	68	77	0.06	64	0.05	11.9	-6.8	13	20.1	16.8	5.6	0.05	-0.02
Hosts and hostesses, restaurant/lounge/coffee shop	158	203	0.17	255	0.20	28.5	61.4	-52	20.3	12.3	10.7	0.28	0.42
Reservation and transportation ticket agents and travel clerks	106	115	0.09	145	0.11	9.0	37.0	-30	20.5	4.8	22.2	0.06	0.17
File clerks	223	231	0.19	292	0.22	3.4	30.6	-61	20.8	16.0	6.8	0.05	0.29
Recreation workers	154	180	0.15	228	0.18	16.8	47.7	-48	20.9	4.1	15.2	0.16	0.32
Psychologists	92	110	0.09	139	0.11	19.8	51.5	-29	21.0	6.5	11.6	0.11	-0.20
Electronics repairers, commercial and industrial equipment	77	91	0.07	76	0.06	18.4	-2.3	16	21.1	15.3	4.4	0.09	-0.01
Bartenders	366	466	0.38	385	0.30	27.4	5.1	82	21.2	35.7	10.9	0.62	0.08
Statistical clerks	69	60	0.05	77	0.06	-12.6	11.4	-17	21.5	16.0	9.2	-0.05	0.03

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Table 2. Total employment by occupation, 1984, 1995, and projected 1995

[Numbers in thousands]

Occupation	Total employment					Percent change 1984-95		Numerical error, 1995 (projected actual)	Absolute percent error, 1995	Absolute percent error, 1995		Share of total job growth 1984-95	
	Actual 1984	Projected 1995		Actual 1995						Actual industry totals to projected staffing pattern	Actual staffing pattern to projected industry totals	Projected	Actual
		Level	Percent share	Level	Percent share	Projected	Actual						
Dentists	160	200	0.16	165	0.13	25.1	2.9	35	21.5	34.9	8.5	0.25	0.02
Tool and die makers	165	178	0.15	146	0.11	8.3	-11.2	32	21.9	7.8	12.2	0.08	-0.08
Radiologic technologists and technicians	109	134	0.11	172	0.13	23.2	58.0	-38	22.0	11.4	11.9	0.16	0.27
Musicians	184	208	0.17	267	0.21	13.0	45.2	-59	22.2	2.4	22.1	0.15	0.36
Accountants and auditors	902	1,213	0.99	991	0.76	34.5	9.8	223	22.5	23.0	0.0	1.94	0.38
Producers, directors, actors, and entertainers	61	76	0.06	98	0.08	23.6	59.7	-22	22.6	2.2	12.6	0.09	0.16
Amusement and recreation attendants	179	218	0.18	282	0.22	21.6	57.2	-64	22.7	1.0	21.4	0.24	0.44
Head sawyers and saw machine operators and tenders, setters and setup operators	75	82	0.07	65	0.05	6.6	-13.1	15	22.7	22.6	1.2	0.03	-0.04
College and university faculty	758	654	0.53	848	0.65	-13.8	11.8	-194	22.8	4.9	18.8	-0.65	0.38
Paper goods machine setters and setup operators	60	63	0.05	51	0.04	4.4	-15.1	12	23.0	27.7	3.7	0.02	-0.04
Sales agents, real estate	291	332	0.27	270	0.21	14.2	-7.2	62	23.1	34.1	5.6	0.26	-0.09
Dispatchers, police, fire, and ambulance	58	64	0.05	84	0.06	10.5	43.6	-19	23.1	10.8	13.9	0.04	0.11
Duplicating, mail, and other office machine operators	152	175	0.14	230	0.18	15.5	51.4	-55	23.7	21.0	9.1	0.15	0.34
Punch machine setters and setup operators, metal and plastic	63	61	0.05	49	0.04	-2.7	-21.4	12	23.9	7.6	12.9	-0.01	-0.06
Flight attendants	68	83	0.07	109	0.08	21.0	59.7	-26	24.2	3.9	27.1	0.09	0.18
Chemical engineers	52	64	0.05	51	0.04	21.8	-2.3	13	24.6	15.3	9.2	0.07	-0.01
Farm workers	1,002	863	0.70	692	0.53	-13.8	-30.9	171	24.7	11.7	6.7	-0.87	-1.33
Postal mail carriers	240	248	0.20	330	0.25	3.3	37.9	-83	25.1	6.6	19.7	0.05	0.39
Radio and TV announcers and newscasters	58	64	0.05	50	0.04	9.9	-12.6	13	25.8	10.2	17.4	0.04	-0.03
Social workers	342	419	0.34	570	0.44	22.5	66.6	-151	26.5	10.5	15.9	0.48	0.98
Barbers	75	83	0.07	65	0.05	9.8	-13.4	17	26.8	30.2	2.1	0.05	-0.04
Station installers and repairers, telephone	58	47	0.04	37	0.03	-18.1	-35.6	10	27.1	7.6	18.1	-0.07	-0.09
Insurance claims clerks	78	87	0.07	120	0.09	12.4	54.9	-33	27.5	22.1	8.7	0.06	0.18
Teacher aides and educational assistants	594	700	0.57	966	0.74	17.9	62.8	-266	27.6	7.6	20.8	0.68	1.60
Sheriffs and deputy sheriffs	61	62	0.05	86	0.07	2.9	42.1	-24	27.7	17.0	12.9	0.01	0.11
Messengers	90	100	0.08	139	0.11	11.2	54.6	-39	28.1	23.8	5.6	0.06	0.21
Correction officers	167	225	0.18	314	0.24	34.5	87.7	-89	28.3	20.0	10.3	0.36	0.63
Civil engineers, including traffic engineers	188	243	0.20	188	0.14	29.4	0.1	55	29.3	22.9	4.9	0.34	0.00
Telephone and cable TV line installers and repairers	123	140	0.11	198	0.15	14.1	61.8	-59	29.5	38.1	13.7	0.11	0.33
Textile machine setters and setup operators	58	49	0.04	38	0.03	-15.4	-34.7	11	29.6	39.1	4.3	-0.06	-0.09

Table 2. Total employment by occupation, 1984, 1995, and projected 1995

[Numbers in thousands]

Occupation	Total employment					Percent change 1984-95		Numerical error, 1995 (projected actual)	Absolute percent error, 1995	Absolute percent error, 1995		Share of total job growth 1984-95	
	Actual 1984	Projected 1995		Actual 1995						Actual industry totals to projected staffing pattern	Actual staffing pattern to projected industry totals		
		Level	Percent share	Level	Percent share	Projected	Actual					Projected	Actual
Industrial engineers, except safety engineers	117	152	0.12	116	0.09	30.0	-0.3	35	30.5	4.9	21.0	0.22	0.00
Vehicle washers and equipment cleaners	165	177	0.14	254	0.20	7.4	54.5	-78	30.5	2.0	29.0	0.08	0.39
Computer operators, except peripheral equipment	241	350	0.29	267	0.21	45.5	11.1	83	31.0	35.3	1.6	0.68	0.11
Machine tool cutting operators and tenders, metal and plastic	172	164	0.13	125	0.10	-4.6	-27.4	39	31.4	17.8	10.4	-0.05	-0.20
Child care workers	511	563	0.46	821	0.63	10.1	60.5	-258	31.4	19.1	15.5	0.32	1.13
Nursery workers	54	58	0.05	85	0.07	6.9	55.8	-27	31.4	16.3	16.1	0.02	0.13
Mechanical engineers	231	309	0.25	233	0.18	33.6	1.0	75	32.3	14.5	14.8	0.48	0.01
Meat, poultry, and fish cutters and trimmers, hand	98	93	0.08	138	0.11	-4.3	41.5	-45	32.4	6.0	27.9	-0.03	0.17
Lathe machine tool setters and setup operators, metal and plastic	99	98	0.08	74	0.06	-0.5	-25.0	24	32.6	13.0	15.4	0.00	-0.11
Grinding machine setters and setup operators, metal and plastic	89	87	0.07	64	0.05	-2.2	-28.1	23	36.1	21.0	13.3	-0.01	-0.11
Drill machine tool setters and setup operators, metal and plastic	65	64	0.05	47	0.04	-0.7	-27.4	17	36.8	16.6	17.2	0.00	-0.08
Electrical and electronic assemblers	256	300	0.24	218	0.17	17.0	-15.0	82	37.6	4.6	43.0	0.27	-0.16
Data processing equipment repairers	61	106	0.09	77	0.06	72.8	24.8	29	38.5	33.2	3.1	0.28	0.07
Switchboard operators	256	330	0.27	238	0.18	29.1	-7.0	92	38.9	48.9	7.4	0.46	-0.08
Electrical and electronic equip assemblers, precision	175	205	0.17	148	0.11	17.5	-15.4	57	38.9	6.8	48.7	0.19	-0.12
Animal caretakers, except farm	71	75	0.06	124	0.10	6.2	75.0	-49	39.3	13.2	22.4	0.03	0.23
Computer programmers	440	782	0.64	559	0.43	77.6	26.9	223	40.0	46.2	3.3	2.13	0.51
Adult and vocational education teachers	303	352	0.29	587	0.45	15.9	93.6	-235	40.1	26.4	15.1	0.30	1.22
Computer systems analysts, engineers, and scientists	306	503	0.41	860	0.66	64.4	180.8	-356	41.5	39.8	3.6	1.23	2.38
Structural and reinforcing metal workers	77	91	0.07	63	0.05	17.8	-17.8	27	43.3	47.6	2.8	0.09	-0.06
Typists and word processors	922	954	0.78	662	0.51	3.5	-28.1	292	44.0	55.5	8.2	0.20	-1.11
Bill and account collectors	112	144	0.12	259	0.20	28.4	131.1	-115	44.5	42.5	3.1	0.20	0.63
Electrical and electronic technicians/technologists	310	460	0.37	316	0.24	48.4	2.0	144	45.5	25.7	17.7	0.94	0.03
Welding machine setters, operators, and tenders	131	157	0.13	107	0.08	19.9	-18.1	50	46.3	29.6	13.8	0.16	-0.10
Reporters and correspondents	69	83	0.07	57	0.04	19.9	-18.2	26	46.6	16.6	10.9	0.09	-0.05
Custom tailors and sewers	112	123	0.10	83	0.06	10.5	-26.1	41	49.4	47.9	3.2	0.07	-0.12
Emergency medical technicians	62	66	0.05	140	0.11	5.3	124.5	-74	53.1	39.0	23.1	0.02	0.33
Electromechanical equipment assemblers, precision	61	75	0.06	48	0.04	24.0	-20.7	27	55.1	0.7	42.3	0.09	-0.05

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Table 2. Total employment by occupation, 1984, 1995, and projected 1995

[Numbers in thousands]

Occupation	Total employment					Percent change 1984-95		Numerical error, 1995 (projected actual)	Absolute percent error, 1995	Absolute percent error, 1995		Share of total job growth 1984-95	
	Actual 1984	Projected 1995		Actual 1995									
		Level	Percent share	Level	Percent share	Projected	Actual			Actual industry totals to projected staffing pattern	Actual staffing pattern to projected industry totals	Projected	Actual
Adjustment clerks	130	158	0.13	384	0.30	21.9	196.0	-226	58.8	59.5	0.4	0.18	1.09
Precision instrument repairers	57	65	0.05	39	0.03	13.4	-31.3	26	65.0	21.4	22.4	0.05	-0.08
Service station attendants	289	287	0.23	167	0.13	-0.8	-42.1	120	71.4	85.6	16.3	-0.01	-0.52
Electrical and electronics engineers	399	607	0.49	353	0.27	52.2	-11.4	253	71.8	41.4	20.2	1.30	-0.20
Roustabouts	78	79	0.06	27	0.02	1.1	-65.2	52	190.1	37.6	114.6	0.01	-0.22

Table 3. Sources of projection error for education-related occupations, 1995, and projected and actual share of total job growth, 1984-95.

	Absolute percent error	Absolute percent error (actual industry totals/projected staffing pattern)	Absolute percent error (actual staffing pattern/projected industry totals)	Share of total job growth	Share of total job growth
				Projected	Actual
College and university faculty	22.8	4.9	18.8	-0.65	0.38
Adult and vocational education teachers	40.1	26.4	15.1	0.30	1.22
Teacher aides and educational assistants	27.6	7.6	20.8	0.66	1.60

Table 4. Sources of projection error for computer-related occupations, 1995, and projected and actual share of total job growth, 1984-95.

	Absolute percent error	Absolute percent error (actual industry totals/projected staffing pattern)	Absolute percent error (actual staffing pattern/projected industry totals)	Share of total job growth	Share of total job growth
				Projected	Actual
Computer programmers	40.0	46.2	3.3	2.13	0.51
Computer operators, except peripheral equipment	31.0	35.3	1.6	0.68	0.11
Peripheral EDP equipment operators	100.7	108.4	4.2	0.12	-0.05
Data entry keyers, except composing	10.7	4.6	7.9	0.01	0.20
Data entry keyers, composing	79.8	79.9	5.3	0.06	-0.03

Table 5. Sources of projection error for health-related occupations, 1995, and projected and actual share of total job growth, 1984-95.

	Absolute percent error	*Absolute percent error (actual industry totals/projected staffing pattern)*	*Absolute percent error (actual staffing pattern/projected industry totals)*	*Share of total job growth* *Projected*	*Share of total job growth* *Actual*
Physicians assistants	42.4	34.7	11.4	0.07	0.16
Occupational therapists	47.4	39.9	13.0	0.05	0.15
Occupational therapy assistants and aides	41.9	33.8	13.6	0.01	0.03
Emergency medical technicians	53.1	39.0	23.1	0.02	0.33
Licensed practical nurses	4.0	10.0	12.6	0.64	0.56

Table 6. Sources of projection error for production workers, 1995, and projected and actual share of total job growth, 1984-95.

	Absolute percent error	*Absolute percent error (actual industry totals/projected staffing pattern)*	*Absolute percent error (actual staffing pattern/projected industry totals)*	*Share of total job growth* *Projected*	*Share of total job growth* *Actual*
Aircraft assemblers, precision	27.1	16.0	52.1	0.02	-0.01
Electrical and electronic equipment assemblers, precision	38.9	6.8	48.7	0.19	-0.12
Electromechanical equipment assemblers, precision	55.1	0.7	42.3	0.09	-0.05
Electrical and electronic assemblers	37.6	4.6	43.0	0.27	-0.16

EARLY WARNING AND THE NEED FOR INFORMATION SHARING

Chair: Kenneth W. Hunter
World Future Society

Early Warning and Futures Research: An Argument for Collaboration and Integration Among Professional Disciplines,
Kenneth W. Hunter, World Future Society

Early Warning and Futures Research

An Argument for Collaboration and Integration Among Professional Disciplines

by

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September 10, 1997

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Early Warning Professional Services and Accountability for Actions and Inaction

Early warning is a professional responsibility and service provided by many disciplines in most institutions to inform direction-setting policy making and implementation, including course corrections and emergency responses. Policy makers and their advisors are accountable for their inaction as well as actions. In the current era of large scale systemic transformations missed opportunities can be very costly to individual institutions and civil society in the long run, thus making accountability for inaction especially important today.

Early warning, like futures research, is not a traditional discipline itself, but is a critical responsibility of most professionals. However, the traditional professions do not use these terms in describing their functions and services. Therefore, we have to look to what they do and what they call it to assess the nature of early warning and futures research methods and practices today. I will begin that task in this paper.

In my judgment, early warning and futures research are based on implicit general mental models of the relationships among values, change drivers and shapers, and institutions. Change drivers include demographic and technologic forces. Change shapers include ecological systems constrains and patterns of change in institutions, such as globalization and restructuring into more modular and networked relationships. These forces impact all institutions and create a wide range of direction-setting policy choices. Values shape the criteria used explicitly and implicitly in making those choices. Inaction is an implicit choice not to change directions by the institution.

Each professional discipline has evolved its own process and language for doing its work. However, all professionals do share responsibilities. All professionals advise their individual and organizational clients on critical choices. They base their advice on their understanding of changing conditions and relative capabilities of the client and their assessment of the likely consequences and risks of alternative actions and inaction. That is what being a professional is all about. As real world situations get more complex -- the choices involve larger scale systems -- we need to engage a wider range of disciplines collaboratively. Since the languages and underlying paradigms are different, policy makers confront a difficult to impossible task of information integration and evaluation of choices.

In my opinion, we in the professions should take the initiative to collaborate and integrate our knowledge and services in support of direction-setting policy making for large scale systems. Let me illustrate. In my view, the following ten large scale human systems are undergoing transformational changes thus driving complex policy choices for everyone:

1. Life relationships: gender, generational, family, rational-creative, spiritual and work.
2. Civil society and communities; neighborhood cohesion; tolerance and cultural passions and identities; confronting enduring ethnic, religious, racial and nationalistic conflicts.
3. Human capacity development: leaning, knowledge building, and wellness
4. Human services for vulnerable and troubled people and peoples to lessen human suffering and build connections to communities.
5. Eco-econo-socio systems: climate change, water, energy, ecosecurity, sustainability.
6. Habitats and mobility: megacities, communities, corridors, gateways, regional systems, and logistics.
7. Big collaborative science..
8. Big emerging markets: China, India, Indonesia, Brazil and Russia.
9. Global standards and best practices; accountability and governance; transparency and reporting.
10. Dealing with wrong-doing: early warning, early intervention, military, police, justice.

In my opinion we do share this agenda of major changes and share a basic mental model as professionals. These provide a starting point for collaboration and integration of our professional knowledge and skills to meet our early warning and futures research responsibilities more effectively.

Early warning of what?

First, however, we need to wrestle with the question "early warning of what?" Policy makers and the public want warning of potential events, changes in relationships, and changes in systems capabilities with possible significant consequences. These of course are interrelated, but the way we think and talk about each is a little different.

Events involve both substantive action and timing. Significant events can be breakthroughs on one end of a continuum and crises on the other. In fact what may be a crisis for some institutions and individuals are likely to be breakthroughs or at least opportunities for others. Actions on tobacco and greenhouse gases are illustrations. By events we usually mean the action that gives public recognition to a major change and drives the need for attention. However, breakthroughs and crises do not happen spontaneously. Collapses of political regimes usually result from long-term disintegration and corruption at the core. Scientific "discoveries" result from years of hard thinking and work to make them happen. Effective monitoring of actions or inaction of key people and institutions can provide early signals of the possibility of a major event at some time. However, anticipating the exact timing of the "capping" event is very difficult, even when they appear to be getting near. Nevertheless, informing policy makers and the public of the nature, likelihood and timing of a major event is a critical early warning service.

Understanding changing relationships is also fundamental to all policy choices. The end of the Cold War, the diffusion of information technology, climate change, and changing gender and generational relationships all make it certain that future conditions will be significantly different. We all do make assumptions about what those changing relationships and future conditions are likely to be and put our professional judgments about them into our policy advice.

Large scale systems and organizations involve well established and routine relationships and thus relatively rigid structures and processes. Political regimes, militaries, social security systems, tax systems, industries, large companies, churches, etc., are all such systems. Significantly changing such systems means changing their design, rules, practices and processes and getting everyone involved to adapt -- changing the culture as well as the structure and functions. These are complex undertakings as we experience with Russia and China and in many traditional industries. Some institutions disintegrate, usually from inaction, incompetence and corruption at the core; they eventually implode. At the same time new ventures are continuously created and some "take off" in a rapid process of integration of knowledge, vision, resources, and opportunities. There are thresholds involved here which when passed result in transformation, takeoff or collapse of the system. Early warning is most effective when we understand the system dynamics and we make informed assessments of the thresholds and monitor movement of systems toward them.

Understanding the likelihood and nature of critical events and changes in relationships and systems requires knowledge and skills from many disciplines. Integrative fields such as ecological security, sustainable development, economic security, human capacity development, human services and humanitarian assistance, bioengineering, etc., all illustrate progress in shaping multiple disciplinary approaches. These enhance our early warning capabilities. We need to do much more such collaborative work.

Early Warning Methods and Practices

I find it most useful to group early warning and futures research professional approaches, methods and practices into five sectors of work: (1) security and politics; (2) business and finance; (3) human rights, development and assistance; (4) ecology; and (5) integration (see attached chart "Defining and Assessing Institutions, Their Important Relationships and Integrative Capacities"). Following thumbnail sketches of the approaches of the groups (these are based on my understanding; I hope to learn and be corrected by people more knowledgeable about each):

1. Security and politics.

Military and political intelligence professionals provide continuous information on changing military and diplomatic conditions, assessment

Defining and Assessing Institutions, Their Important Relationships and Integrative Capacities

Kenneth W. Hunter
Rima Shaffer
July 8, 1997

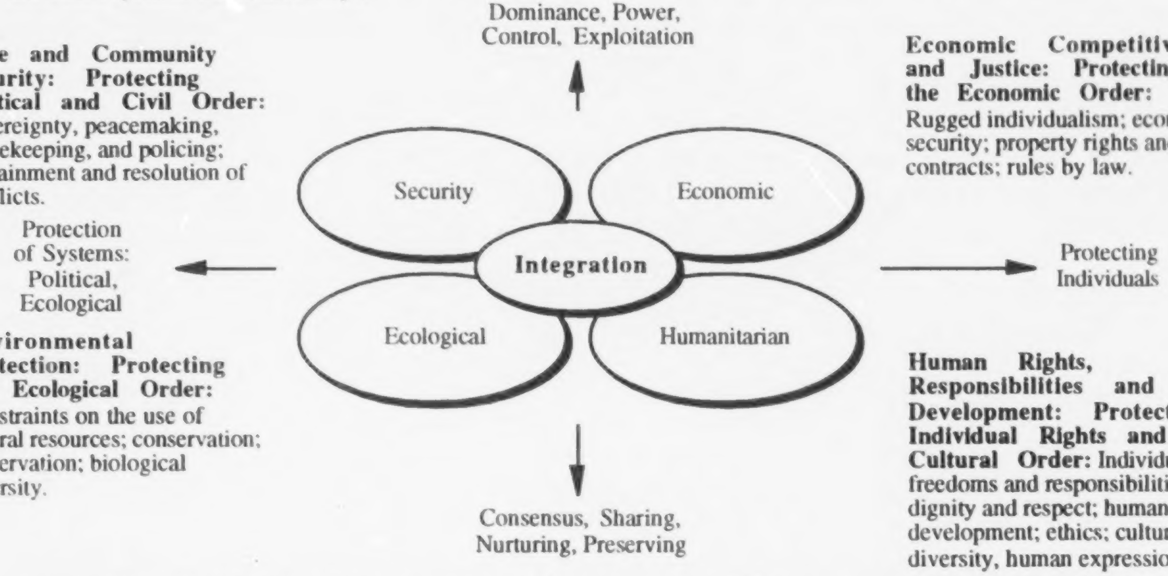
1. Boundaries of the institutions and its environment as part of systems: geopolitical, socioeconomic sectors, interest groups and networks, ecological.

2. Relationships: common boundaries, stakeholders, sister communities, competitors, customers, collaborators, systemic connections and integration. Effective socio-economic institutions are built upon effective relationships. Effective relationships are built upon understanding, trust, communications, competence and shared visions of possible and preferable future conditions, opportunities and challenges.

3. Understanding and evaluating five communities of concern and capabilities of all institutions and the dynamic tensions inherent in their systems and relationships:

State and Community Security: Protecting Political and Civil Order: Sovereignty, peacemaking, peacekeeping, and policing; containment and resolution of conflicts.

Economic Competitiveness and Justice: Protecting the Economic Order: Rugged individualism; economic security; property rights and contracts; rules by law.


Dominance, Power, Control, Exploitation
Security
Economic
Protection of Systems: Political, Ecological
Integration
Protecting Individuals
Ecological
Humanitarian
Consensus, Sharing, Nurturing, Preserving

Environmental Protection: Protecting the Ecological Order: Constraints on the use of natural resources; conservation; preservation; biological diversity.

Human Rights, Responsibilities and Development: Protecting Individual Rights and Cultural Order: Individual freedoms and responsibilities, dignity and respect; human development; ethics; cultural diversity, human expression.

4. **Integration**involves balancing competing rights and competing responsibilities; setting and changing directions; fostering inclusion, collaboration and dialogue; and continuous exploration and assessment of ideas, paradoxes, conditions. Integrative capacity draws upon the full range of disciplines and thinking approaches, human expression, philosophy, theology, integrative dimensions of science, knowledge building, and continuing search for wisdom. Integration requires comprehensively and simultaneously engaging a wide range of institutions and the use of our full tool kit of relationship, trust, network and instituti building approaches and methods. It also demands respect, patience, persistence, and comfort with ambiguity, uncertainty, constant change, use of intuition, and continuous search for shared interests. It involves recognizing where possibilities for integration exist and acting to create collaboration for new initiatives; framing open questions and ideas and avoiding either/or situations; inclusion of nontraditional approaches and people who would not usually be included or would not think to include themselves; recognizing that each collaborator will add a fuller understanding and enrich the array of approaches to solving problems; and continuously dealing with the tensions created by the needs for completion of tasks, broad inclusion, and dynamic of interactions among people and groups.

information on potential threats and risks of military and diplomatic conflicts, analytic information on alternative strategies and their likely consequences. It uses massive information collection (by both human and electronic observation and interception) and analysis capabilities and has used a closed and compartmentalized organization and reporting structure. It has evolved its own means and methods and traditionally has been reluctant to share information, methods or models with others. Today the intelligence community is actively seeking to connect with other communities to broaden its scope and services.

Criminal intelligence provides information on alleged criminal activities for community security, law enforcement, and criminal prosecution. It uses a wide range of investigatory means and methods, involving field investigations, monitoring, and scientific analysis of evidence. Organized crime, drug trafficking and corruption are major systematic focuses. Early warning has not been an explicit, priority function. However, recognition of (1) the extent and negative impacts of corruption on civil society and economic development and (2) the threats to financial systems of large scale fraud, calls for the criminal justice community to work on such political and business systems problems. Similarly, the prosecution for war crimes brings criminal justice people directly into the horrific actions and hostile conditions of failed states. However, as we develop more integrated approaches and methods of dealing with criminal systems, the traditional separation of military and police functions by the United States and other developed countries is being breached. This illustrates the importance of values in shaping collaborative institutions.

Country financial risk assessment and early warning of financial trouble are functions of the international and United States financial institutions with the International Monetary Fund and the US Export-Import Bank having operational activities. These institutions have extensive financial exposure in troubled countries and have had significant losses in several failed states. They now are broadening the range of factors they formally consider in assessing risk to include non-financial factors. They are extending their collaboration accordingly.

2. Business and commercial finance.

Business intelligence and risk assessment include an expanding array of commercial analytic services. An example is The Economist Intelligence Unit, which integrates information from the various econometric services with the journalistic coverage of the Economist and Financial Times news service. These services cover not only economic conditions, but political, social, and environmental conditions and trends. While they are relatively short-term in their focus, they do discuss long-term structural changes of major significance. The commercial financial community also uses many rating and risk assessment practices, such as those of Dunn and Bradstreet. To be effective the rating services must be anticipatory and provide early warning for investors.

Economic indicator functions provide information on trends in economic conditions and serve to guide economic research and policy analysis. These services use statistical (survey and time series) methods. Their processes are open; their information is disseminates and uses widely. They have evolved well structured and disciplined approaches and methods that they enthusiastically share in the belief that the indicators will be improved as user provided feedback to guide enhancements. The models used are of economic relationships and systems. Major restructuring of international economic and political relationships, industries and organizations is driving the demand for overhauling economic models and statistical series to reflect new reality.

Corporate public issues management is a professional approach to identifying and addressing emerging and emergency public policy issues by some businesses. Anticipating potential public issues and being prepared to engage in shaping policy responses is the objective. A network of professional corporate public issues managers share experiences.

Corporate strategic planners tend to focus on the organization and its operations over the next few years. However, the initial steps in their processes do frequently involve external and longer-term inquiry. These include identifying a range of demographic, technological, socio-economic, and political changes; creating a set of forecasts of plausible future conditions 5 to 10 years ahead; and designing alternative business strategies for the transition period. This type of analysis can identify needed policy changes to guide organizations or sectors toward preferred future conditions and away from adverse conditions. Professional associations of planners share methodological experiences. Real corporate strategies are highly confidential.

Market research is one of the most extensive and intensive early warning and futures research business functions. Business choices about markets and products and service design and delivery bring together information, ideas and judgments from all disciplines and functions. Market research uses a wide range of survey methods combined with demographic analyses. They monitor customer opinions and satisfaction closely. New ideas are field tested. They monitor competitors and their customers also. They assess changing markets rigorously. Product, service and market policies are reconsider regularly. They evaluate successes, failures, and missed opportunities for lessons learned. They consider this intelligence and their decisions highly confidential and do not share anything.

Financial auditing and reporting provide information to policy makers and the public on financial conditions of organizations. Accountants' responsibility for assessing enterprise's capacity to continue as a "going concerns" is a critical early warning function. The accounting profession has standards for reporting and auditing. Most countries use certification and licensing of individuals. With globe spanning, real-time financial markets and systems and organizational networks, where does the boundary of the entity being audited end for purposes of determining its financial condition and "going concern" capabilities? What are the entity's long-term financial risks for environmental and health damage? What is the "going concern" status of an enterprise that is not changing? The auditing community (of which I am a member) has hardly begun to open this Pandora's box. To do so will require broad collaboration and integration with other disciplines. I believe that is achievable.

3. Human rights, development and services

Human rights monitoring has focused on calling attention to ongoing violations of human rights and seeking actions to stop the practices. Through networks of volunteer and professional observers using increasingly rigorous documentation, communications, and advocacy methods human rights violations have become better understood and reported. Early warning has involved identification of minorities at risk of abuse and of patterns of behavior by regimes that typically include human rights violations. Today greater attention is being given to employing statistical methods, integrating human rights monitoring with policy making, providing public information and education, broadening monitoring capabilities, and expanding preventive approaches. Models are of patterns of abuse and of dispute and conflict processes. These activities are open and increasingly involve integration with other policy areas, including the linkage to trade and investment practices. In my opinion the human rights treaty regimes and the supporting reporting requirements provide a potentially effective basis for assessing country accountability for political, social and economic conditions and their plans and progress in meeting basic human needs.

Emergency management and human services include anticipation of possible disasters and creation of response capabilities. The United Nations High Commissioner for Refugees, Red Cross, CARE, and other relief organizations are the front line of services. Since they respond to all types of disasters, they use a mix of early warning approaches drawing upon the services that forecast natural disasters, the intelligence services warnings of military and political conflicts, and their own vast network of people in the field. They strive to integrate their activities with other international and national organizations that have responsibilities and capabilities for addressing emergency conditions. Their work is open and cooperative. The models used are of disaster relief and recovery processes. Human made disasters in Central

Africa, Somalia, Bosnia, Cambodia, and more continue to drive the search for more effective early warning and early intervention approaches and methods. However, the international institutions are unable to intervene unless requested by the sovereign government which is usually unwilling or unable to do so early enough.

Community and regional human service providers wish to move toward more integrated preventive and anticipatory approaches to meeting the needs of vulnerable people. Human service professionals have traditionally used diagnostic and remedial approaches and a wide range of specialists and specialized services. The reason for the renewed interest in integrated and early assistance is recognition that people and groups in vulnerable conditions have a wide range of problems and require more integrated strategies to work their way out of them. We need to devote more attention to identifying the early signals of deteriorating conditions and strategies for early support.

Social indicators, to parallel the economic indicators, have been evolving in the United States and internationally. The Federal Forecasters network, the Social Indicators network, counterparts in other regions, and the United Nations Statistical Office could serve as focal points and facilitators for continuing improvement of social statistical systems. However, there is no consensus on key indicators of social conditions and the specific roles they could play in policy making. There is no early warning capability. The human rights treaty regimes provide a generally agreed upon set of socio-economic factors that I believe should be the foundation for social indicators work. However, there is little professional integration between the human rights monitoring and the social statistics professional communities.

Disease control and prevention professionals provide information on disease conditions and forecasts of their spread and likely health and health care impacts. Health care providers and health researchers in the field provide data through international reporting systems; then disease control groups analyze it. They use survey research methods extensively. These activities are open and involve extensive sharing of data, methods and models. The scientific method guides this work. They operate a variety of notifications and public educational processes. The extent of collaboration with others is illustrated by the current work on the potential long-term health effects of global climate change and from increased attention to the threats of micro-organisms.

4. Ecology

Ecosystem monitoring provides information on ecological conditions and forecasts potential crises, including storms and earthquakes. The models used are of natural systems and the data is acquired by physical monitoring. More recently attention is on global modeling and analysis of the interaction of natural systems and human built and operated systems. The purpose is to assess the potential consequences of long-term demographic and technological changes and industrial development on the global ecosystem and the consequences of climate change. These activities are open and involve extensive collaboration and sharing of data, methods and models. The scientific method guides this work. Weather forecasting and earthquake monitoring are the most developed systems. The work on climate change being coordinated by the World Meteorological Organization's Intergovernmental Panel on Climate Change illustrates the capacity to draw upon the knowledge of scientists from around the world and to synthesize their contributions into an integrated report for the public, peers and policy people.

Local ecosystems are also being examined. Work over several decades on the Chesapeake Bay and newer work on the Lake Tahoe ecosystem are illustrative. In each case, early warnings of deteriorating water conditions drove action to establish extensive regional collaborative monitoring and evaluation processes. The President's Council on Sustainable Development serves to foster these initiatives and to support the sharing of expertise.

Eco-diplomacy by international institutions can serve as an early warning capability on potential ecological crises and conflicts. This new initiative can serve to draw together information from monitoring systems around the world to document and report on changing ecological conditions. This knowledge can be used with the many stakeholders involved to collaboratively seek means of avoiding conflict and ecological crises and design pathways to sustainability.

5. Integration for policy makers and the public

Futures research can serve as an integrative function. It does not do it now. I am developing initiatives through the World Future Society's Professional Membership, The Harrison Program on the Future Global Agenda of the University of Maryland, and Collaborative Futures International. The World Future Society, with a general member of 30,000 and a professional membership of 1,500, provides publishing and convening services. The Harrison Program is the home of the Society's professional membership, conducts education and research programs on major global issues and structural changes. Collaborative Futures International is being designed to support the design and development of collaborative programs and to support the establishment of centers for convening, learning and knowledge sharing, and futures research. We are developing a proposal for a "Global 2030 Program" that will serve to integrate our best knowledge about the world over the first three decades of the next century; ideas and collaborators are being sought. A five-year calendar of events is being developed.

Technology forecasting and assessment have served as a major integrative service. The former Congressional Office of Technology Assessments (which the Congress abolished in the Fall of 1995) described its work as providing decision makers "with objective analyses of the emerging, difficult, and often highly technical issues of our time." The act establishing OTA specified:

> "The basic function of the Office shall be to provide early indications of the probable beneficial and adverse impacts of the applications of technology and to develop other coordinate information which may assist the Congress. In carrying out such functions, the Office shall: (1) identify existing or probable impacts of technology or technological programs; (2) where possible, ascertain cause-and-effect relationships; (3) identify alternative technological methods of implementing specific programs; (4) identify alternative programs for achieving requisite goals; (5) make estimates of alternative methods and programs; (6) present findings of completed analyses to the appropriate legislative authorities; (7) identify areas where additional research or data collection is required to provide adequate support for the assessment and estimates described in paragraphs (1) through (5) of this subsection; and (8) undertake such additional associated activities as the appropriate authorities ... may direct."

This charter clearly linked early warning with decision making and directed OTA to perform the policy analysis functions needed to make the connections. We still need such technology assessment services. Several former leaders of OTA have created the Institute for Technology Assessment to do that.

Formal and prominent policy planning and evaluation functions in the Federal government were abolished in 1981 and have not been reestablished in any organized form. Existing Inspector General, General Accounting Office, and staff offices are reactive for the most part and very narrow in their approaches. While they could serve integrative and policy level early warning services, they do not. One of these days something will happen to drive the rebuilding of policy integration capabilities in the Congress or the Executive branch. This should not be recreation of the old approach. We should base it on today's and tomorrow's technology. Design and development of "decision technology systems" should be one element. Another should be a focus on policy implementation, including the identification of possible implementation obstacles. By mapping the path of implementation through the full array of institutions and processes involved in carrying out a policy direction or change, it should be possible to identify and assess the likely responses of stakeholders. This procedure can provide early warning of the risk of delay, blockage, or redirection during implementation. Policy evaluation professionals should monitor actual implementation and focuses on systemic weaknesses and obstacles. The models used in this type of work would be of bureaucratic and decision making processes and organizational behavior and development. While today we are in the middle of major restructuring of policies, programs and organizational relationships, little attention is being given to the implementability of the proposed changes -- little early warning is being provided.

I have outlined this range of approaches to make two points. First, there is a rich array of capabilities for early warning and futures research support for policy making. Second, we need collaborative approaches. For example, early signals for assessing the risk of failure of a state or other system can come from any of these sources. Signals coming from multiple sources can more quickly provide a picture of a deteriorating situation. Furthermore, very early signals can come from monitoring the extent to which a state or other institution is not responding to long-term structural changes in its environment -- is falling behind by inaction. Demographic, technological and ecological forces are very slow to impact institutions until they pass some thresholds of tolerance. We can creating integrating and boundary-spanning theories, methods and practices.

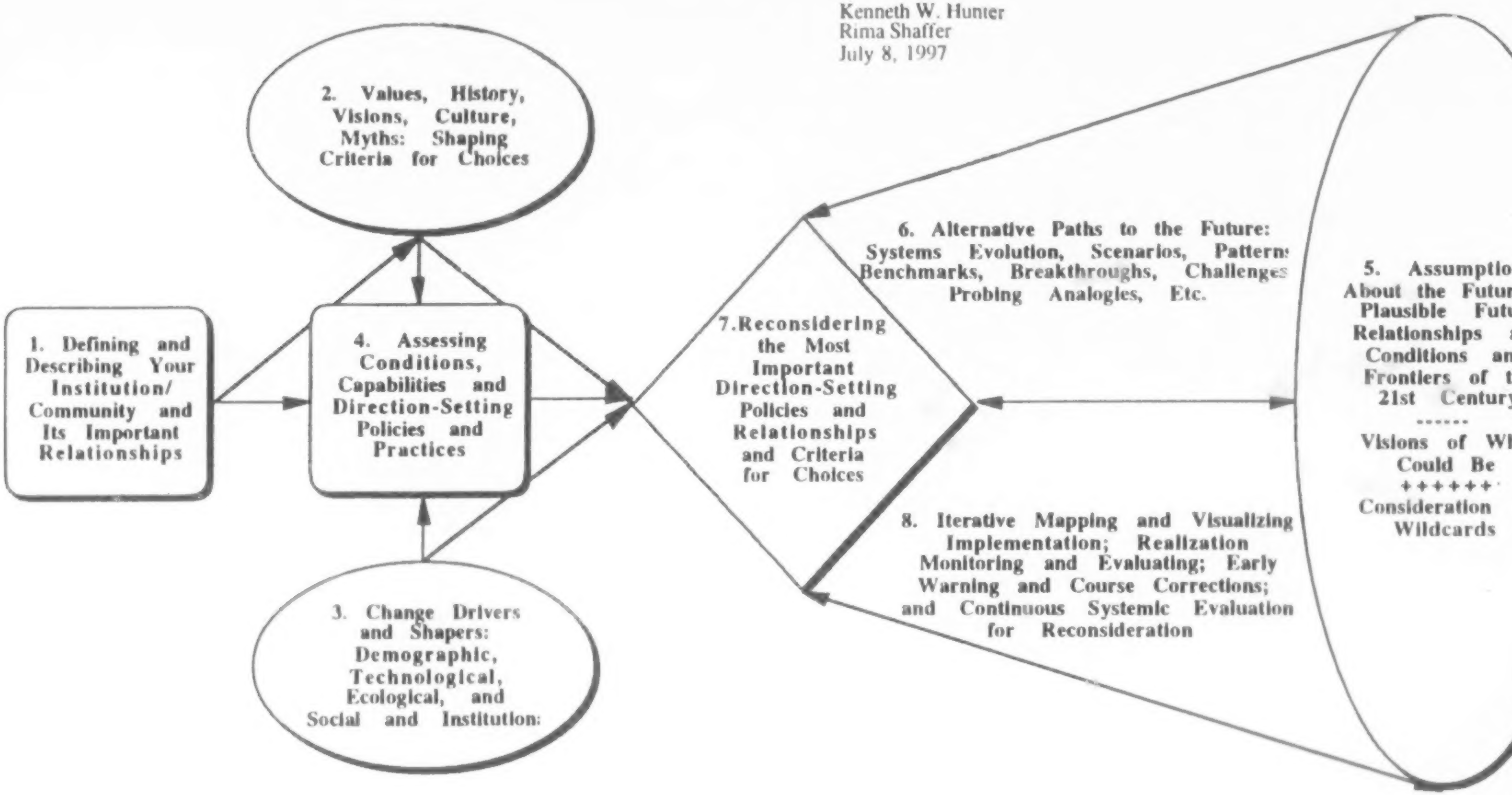
Common early warning and collaborative futures program functions and general process

In all types of professional work common functions and processes have evolved. Professional associations develop and test theories and share ideas and experiences, and refine processes and practices. In my view, for early warning and futures research the following eight-steps comprise a general process. (My colleague Dr. Rima Shaffer and I have developed this model for use with organizations and groups interested in adding futures research thinking and methods to their decision making processes; a book is under way.) Following are sketches of the eight steps illustrated in the chart.

1. Define and describe the target systems and institutions, their core processes, and their important relationships visually and analytically. The entities for which policy is being made include countries, regions, communities, business sectors, corporations, nonprofit enterprises, religions, public services, human rights and responsibilities, scientific sectors, etc. Five key features of systems need to be addressed. (1) The major components of the organization and its infrastructure. (2) The core capabilities, including knowledge, skills, techniques, and talent. (3) Important relationships and the strength of the connections -- boundary spanners, gateways. (4) Important flows of ideas, people, information, financial resources, products and services, etc. (5) Evolution -- important processes of change, pioneering, adaptation and periodic transformation. From this information we can define the boundaries of the system and institutions and the nature of its connections with others.

Designing a Dynamic Eight-Step Process for Shaping Direction-Setting Policies and Relationships

Kenneth W. Hunter
Rima Shaffer
July 8, 1997



1. Defining and Describing Your Institution/ Community and Its Important Relationships

2. Values, History, Visions, Culture, Myths: Shaping Criteria for Choices

3. Change Drivers and Shapers: Demographic, Technological, Ecological, and Social and Institutions

4. Assessing Conditions, Capabilities and Direction-Setting Policies and Practices

5. Assumptions About the Future - Plausible Future Relationships and Conditions and Frontiers of the 21st Century
------
Visions of What Could Be
++++++
Consideration of Wildcards

6. Alternative Paths to the Future: Systems Evolution, Scenarios, Patterns Benchmarks, Breakthroughs, Challenges Probing Analogies, Etc.

7. Reconsidering the Most Important Direction-Setting Policies and Relationships and Criteria for Choices

8. Iterative Mapping and Visualizing Implementation; Realization Monitoring and Evaluating; Early Warning and Course Corrections; and Continuous Systemic Evaluation for Reconsideration

2. Understand the values, history, visions, culture and myths that shape the criteria for making choices. Every institution and the people operating in it make their day-to-day decisions and shape their actions and relationships on the basis of their understanding of the values of the entity and their own. These values and behavior evolve and comprise a culture. Responses to earlier events and shared expectations help shape these values. In organizations, we articulate them as myths and visions, missions and goals, codes of conducts, guidelines and operational manuals, and in our continuous dialogues about the enterprise. Understanding why an institution works the way it does, why it makes the choices it does and thus how it is likely to respond to early signals of change requires deep understanding of its values.

3. Understand major change drivers and shapers and their impacts on current and future conditions. Early warning and futures research involve extensive and intensive monitoring, forecasting and impact assessment of at least four groups of change drivers and shapers. (1) Demographic change drivers, including population growth globally and locally, differential growth among regions and groups, differential income and wealth among regions and groups, aging and increases in longevity, and increases in mobility. (2) Technological change drivers, including the increasing array of digital technologies, advances in the biological technologies, new and improved materials, new nano technologies, and continuing struggles with nuclear technologies. (3) Ecological change shapers, including climate change, usable water limits, ecologically sustainable energy sources, maintenance of biological diversity, and human relationships with microorganisms. (4) Macro patterns in institutional change that shape individual entity's environment, including globalization processes, shifting from hierarchical to more modular and networked structures, acceleration in the pace of change, becoming real time all the time with global communications and mobility, and renewed emphasis on ethics, openness and rule by law. In addition, we need to identify and assess change drivers that are specific to the institutions we are working with.

4. Assess current conditions, capabilities and direction-setting policies and practices. Brutally honest and rigorous assessments are hard to do before a crisis occurs. Nevertheless, effective early warning and futures research are dependent up it. Auditing, investigating, inspecting, surveillance, and many other such functions provide information and evidence of conditions. Process and policy evaluation provide information for assessing current practices as well as policies, since practices may be at odds with policy. In some cases practices lag in implementing changes and in others they are pioneering work well ahead of current policy.

These first four steps involve understanding the present situations as thoroughly and rigorously as we can. The next two steps jump to the future.

The last two steps focus on present direction-setting policy choices and their implementation.

5. Assumptions about the future -- visions of what conditions could be several decades ahead. Futures research work underlying impact assessments in Step 3 above also shapes assumptions about the next few decades. Forecasting and statistical capabilities allow us to make fairly useful sets of demographic and infrastructure assumptions about the next three decades -- the next generation of people and the useful life of much infrastructure. Using 2030 or so as the foresight period also shifts the nature of the policy discussion to "the legacy for future generations" by actions of current policy makers. One set of assumptions includes those that are highly probable -- providing a relatively surprise free vision of the future. In addition, we need to define sets of potential crises and breakthroughs that would result in significantly different futures. Each disciplinary group has its forecasters and sets of assumptions and visions. Policy analysis and futures research can integrate them for use in policy making.

6. Analysis and consideration of alternative paths to the future -- systems evolution, scenarios, patterns, benchmarks, breakthroughs, challenges and threats, probing analogies, etc. Today scenarios are a popular practice for describing and considering policy options and their consequences. Whether developed as such stories or as more rigorous policy and implementation analyses, “alternative paths to the future” are critical features of early warning and futures research work or at least they should be. My preference is to use our full professional policy analysis tool kit rather than relying on one or a few tools. Modeling the system or institution, developing alternative paths, conducting implementation analyses of alternatives, assessing costs and benefits, etc., are all necessary components. Information and analytic technologies make this work far more effective today. We should be giving great attention to the integration of our approaches and methods into “decision technology systems.” (I have been thinking about designing decision technology systems for some time and now believe the latest technology is making it really possible now. In addition, Dr. Shaffer and I are developing an organizational behavior and development continuum approach for creating sets of scenarios for more tailored to setting direction-setting policies.)

7. Reconsider important direction-setting policies and relationships and criteria for choices. Today changing conditions are forcing reconsideration of policies everywhere. Will ideology and political power overwhelm the normal analytic and dialogue phases of policy reconsideration? In the 1970s we gave much attention to the systematic reconsideration of public policies. The driving proposal was for “sunset” provisions to be incorporated into all legislation authorizing major programs. This was to serve as an action forcing mechanism for reconsideration. While the idea died and most forms

of systemic policy work were discontinued in the 1980s, the need still exists and the political institutions are in gridlock over their incapacity to do this core function. Nevertheless, professionals and professional institutions need to be more rigorous in their work and advising of policy making institutions. This means doing all the functions described above continuously in order to be able to synthesize knowledge for use by the public and policy makers in their own ways in the chaotic policy arenas of the non-analytic real world. We need to give special attention to reconsideration of the criteria for choices -- the values underlying all of the evaluations, dialogue and debate. Values, facts and opinions get hopelessly confused in the public discourse and it is the continuing responsibility of professionals to clarify wherever possible during the policy making process. Mixing lobbying and special interest advocacy with professional analysis and advising undermines the credibility of the latter and contributes to the public and political confusion, cynicism and gridlock. It is up to the professions to address the conduct of their members.

8. Iterative mapping and visualizing implementation; realization monitoring and evaluation; early warning and course corrections; and continuous systemic evaluation for reconsideration. Choosing a new policy direction is just one step in a continuous process. Implementation is the path to realization. We need to provide visions and maps for guiding implementation. We monitor and evaluate changing conditions, provide early warning, and offer course corrections. Thus the iterative cycle of professional work continues.

Evaluation of early warning and futures research performance

How should our professional early warning and futures research work be evaluated? Using the "accuracy of our forecasts and warnings" as the key measure is inappropriate and counterproductive. If we do our work effectively it should not include "forecasts" but should present ranges of plausible assumptions about the future. We should present "warnings" as likely consequences of inaction or specific proposed actions. Furthermore, policy action and implementation will change the future, making our earlier analyses outdated.

We should be evaluated on the effectiveness of our informing policy makers and the public. It seems to me there are three dimensions of such evaluation. First is the assessment of the policy makers with whom we work and who use the knowledge we develop in collaboration with them. Second is the public judgment of our service which to a large degree is filter through the media with whom we deal directly as information users and as professional peers. This leads to the third dimension that is the judgment of ourselves as professional peers.

Credibility of all professions is dependent upon their own capacity to establish and adhere to performance and conduct standards. Early warning and futures research are in their infancy in this regard. Establishing professional groups to continuously examine theories, methods and practices in use and proposed is an important first step. In my view we should strive to strengthen the early warning and futures research component of each professional discipline while also developing integrative theories and methods.

Closing

The purpose of this paper has been to pull together my own thoughts on early warning and futures research in order to participate in dialogues on strengthening our services to policy makers and the public. I look forward to engaging in these dialogues at upcoming meetings being convened by the National Intelligence Council, the Federal Forecasters Conference, The Harrison Program on the Future Global Agenda, the World Future Society, and in other forums. We have not had such a serious professional dialogue for several decades and I am pleased to participate again.

Again, I encourage you to join in the professional meetings and collaborative futures programs being developed. My coordinates for contact are on the cover.

FORECASTING PROGRAM EXPENDITURES

Chair: Karen S. Hamrick
Economic Research Service, U.S. Department of Agriculture

Projections of Elementary and Secondary Public Education Expenditures by State,
William J. Hussar, National Center for Education Statistics
U.S. Department of Education

Medicaid Forecasting Practices,
Dan Williams, Baruch College

Consumer Health Accounts: What Can They Add to Medicare Policy Analysis?
R. M. Monaco, INFORUM, University of Maryland, and
J.H. Phelps, Health Care Financing Administration

PROJECTIONS OF ELEMENTARY AND SECONDARY PUBLIC EDUCATION EXPENDITURES BY STATE

by
William J. Hussar
National Center for Education Statistics

I. Introduction

The National Center for Education Statistics (NCES) has been producing projections of education finance statistics at the national level for approximately twenty-five years. For the first time, NCES is investigating the development of state projections for one of its finance statistics, public elementary and secondary current expenditures. This paper presents a methodology for producing a set of preliminary state current expenditure forecasts. Two tests of these projections are examined later in this paper.

The first of this paper's eight sections is this introduction. The second section is a review of the literature on examining current elementary and secondary school expenditure using time series data.

The third section presents the five combinations of estimation technique and pooling techniques which were used in this analysis, as well as the sources of the data.

The fourth section examines a model for elementary and secondary expenditures similar to one that Stephen Barro developed in the early 1970's. This model was estimated using the five estimation/pooling techniques presented in the third part of this paper. Ex-post mean absolute percentage errors (MAPES) were calculated for each state using the five estimation/pooling techniques. These MAPES are examined, together with those from a naive model in which current expenditures in each state were assumed to increase throughout the forecast period at the average annual growth rate of the previous three years.

The results concerning the estimation coefficients largely followed expectations for each of the estimation/pooling techniques. Using the ex-post MAPEs as a measure of forecasting ability, one estimation/pooling technique was found to be superior.

While the Barro model performed well, there was a serious problem with using it to produce state projections: there are no independently produced projections of one of its key independent variables and of the price deflator used for current expenditures. Hence, an alternative model was produced for which there are forecasts for all the variables. Both the coefficients and the MAPEs of alternative model were examined in the fifth section of the paper. The results were very similar to those from the Barro model and again the results for one estimation/pooling technique were superior. Following Barro's example, Alaska and Hawaii had been excluded from the sample. They were included in a final set of estimations.

Two sets of state projections were produced. The first set was produced using the model developed in section five. An alternative set is the one presented in this paper, in which the state projections have been adjusted to equal the national totals from the *Projections of Education Statistics to 2005*. The *Projections of Education Statistics to 2005* was used in the adjustments as the forecasts underlying the projections presented in that edition were produced about the same time as those used here.

In the seventh section, the results from two tests of the state forecasts are examined. In the first test, the projections for 1993-94 are compared to the actual values produced by National Center for Education Statistics. In the second test, the projections for 1994-95 and 1995-96 are compared to the National Center for Education Statistics most recent Early Estimates. Of these tests, the first is obviously the strongest. The other test can only indicate if a state's projections seem grossly wrong.

In the final section, there is a summary and a discussion of possible future work in this area.

II. Review

There has been a large body of work, both theoretical and empirical, on the demand for local public services such as education. In most models, there are typically four types of variables; 1) a measure of income; 2) a measure of intergovernmental aid for education; 3) a measure of the price of providing one more dollar of education expenditures per pupil; and 4) one or more measures of voter tastes for education. Largely consistent results have been found for a great number of empirical studies which have been conducted using this framework. Most of the empirical work on education expenditures has used cross-sectional data. There has been a limited amount of work using data which are simply time series data or are pooled time series and cross-sectional data.

As noted in the introduction, the National Center for Education Statistics (NCES) has been producing projections of national education statistics for twenty-five years. It has been producing projections of elementary and secondary current expenditures using an econometric model yearly since 1987.

The national NCES model has three independent variables; one for each of the first three categories of variables mentioned above; 1) personal disposable income per capita in real dollars, 2) revenue receipts from state sources per capita in real dollars, and 3) the ratio of the enrollment to the population. (While the ratio of enrollment to the population was not a direct measure of the price of education, it was a measure that had been successfully used in other studies.)

In the early 1970's Robert Barro developed a model for the demand for education expenditures by state. This model could have been used to produce state level expenditure forecasts though it does not seem to ever have been used for that purpose. It is that model that forms the basis for the analysis presented in this paper.

Barro examined education expenditures using pooled time-series cross-sectional data. He conducted his analysis using data for the contiguous states for every other school year from 1951-52 to 1967-68. Barro's model had as its dependent variable school spending per pupil in real 1964-65 dollars. Barro used an education price deflator that he developed for this study.

The Barro model can be found in table 1. It had seven independent variables. Three of these, income per capita in real dollars, the sum of state and federal aid for education in real dollars, and the ratio of the enrollment to the population multiplied by the ratio of an education price index and the CPI, corresponded to each of the first three types of variables listed above. The coefficients of those three variables were all significant and followed expectations.

The Barro model had four additional variables. A change in the enrollment was found to have a negative impact on expenditures. Having a low population density was found to have positive effect on education expenditures. There were two variables which measured the impact of being of a state being in the South. These two variables had opposing effects on current expenditures for the southern states: a dummy variable for southern states had a negative coefficient yet a variable which measured the different impact of aid in the South had a positive coefficient.

III. Estimation/Pooling Techniques and Data Sources

A. Estimation/Pooling Techniques

The two models presented in this paper were estimated using five different combinations of estimation techniques and the methods for pooling the data: 1) all the states were pooled together and ordinary least squares (OLS) was used to estimate the model; 2) the states were pooled into nine regions, OLS was used to estimate the model, and there were state dummy variables; 3) the states were pooled into nine regions and one of several generalized least squares techniques was used to estimate the model; 4) the model was estimated for each state using OLS; and 5) the model was estimated for each state using AR1. (Also see table 2.)

As noted above, there are several alternative specifications for the generalized least squares technique. Kmenta suggests one specification, the cross-sectionally correlated and time-wise autoregressive procedure for a sample such as the states of the United States.

The cross-sectionally correlated and time-wise autoregressive procedure of the econometrics package SHAZAM was used when the model was estimated using the generalized least squares technique.

The nine regions used in this analysis can be found in table 3.

B. Data

A data base similar to that used by Barro was constructed. Following Barro, it consisted of data for each of the forty-eight contiguous states and the District of Columbia for each year from 1970-71 to 1992-93. Data for Alaska and Hawaii were also collected but were not used in the initial estimations of the models.

Most of the historical education data were from NCES's Common Core of Data. This included data for current expenditures, revenue receipts from state sources, revenue receipts from federal sources, and enrollment as measured by average daily attendance.

The economic consulting firm DRI/McGraw-Hill provided the historical data and the forecasts for disposable income, state and local government tax payments by state. DRI/McGraw-Hill also provided the national consumer price index and the national price deflator for personal consumption expenditures which was used to place disposable income in constant dollars.

The economic projections from DRI/McGraw-Hill were produced in early 1995, shortly after the production of the forecasts of the national economy used in production of the *Projections of Education Statistics to 2005*. As the projections were produced close in time, the state productions will be treated as if they had been produced with the *Projections of Education Statistics to 2005*.

Forecasts for average daily attendance for each state were required, both to be used as a component of an independent variable and also to produce forecasts for total current expenditures. Two sets of projections were produced for each state. The first set of forecasts for each state was calculated by multiplying each state's fall enrollment projections as presented in the *Projections of Education Statistics to 2005* by that state's average value of the ratio of average daily attendance to the population for the previous ten years. This method is similar to the method used to produce the national projections for average daily attendance. A second set of projections was produced for each state by altering each state's projection by the same percent so that the sum of the state projections equaled the national projections in the *Projections of Education Statistics to 2005*.

A Barro type education price index was constructed by using the National Education Association's teacher salary time series to measure personnel costs and the consumer price index to measure other costs.

IV. The Barro Model

This part of the paper presents the results from the re-estimation of the Barro model. The results of the estimations of the Barro model using each of the pooling/estimation techniques are compared using ex-post MAPEs.

Table 4 contains specifications of the Barro model for each of the five estimation/pooling techniques. Unlike Barro's original estimations, most of the variables were in log form. The log form was used for all the estimation presented in this paper because of results from Box-Cox tests for functional form that were conducted when preparing the NCES national projections.

The only time the specification was identical to that used by Barro was when the data were pooled nationally and ordinary least squares was used.

When the states were broken up by region or state, there was no reason for either the SOUTH dummy variable or the variable LTGRANTS to be present. Further, in some of the regions, there was no variation in the density variable. Hence, when estimating the Barro model using data pooled either regionally or by state, those three variables were excluded.

A. Results of the Estimations

Table 5 shows a summary of the estimations of the Barro model using the five estimation/pooling techniques. (The results for each estimation are available in a longer version of this paper available from the author.)

Ordinary Least Squares with Data Pooled Nationally

These results are similar to those from the original study by Barro presented in table 1. The coefficients of all the variables except the change in enrollment variable (GRADA) had the same signs as in the Barro study and were significant.

Ordinary Least Squares, Data Pooled Regionally, and Dummy Variables

The coefficient for the income, state aid and price variables were significant for most of the regions. The coefficient for the change in enrollment variable was significant for only two regions.

Generalized Least Squares and Data Pooled Regionally

The coefficient for the income, state aid and price variables were significant for most of the regions. The coefficient for the change in enrollment variable was significant for only three regions.

Ordinary Least Squares and Each State Examined Individually

For most of the states, the coefficients of the income and price variables were significant. For about half the states, the coefficient of the state aid variable was significant. For less than half the states, the coefficient for the change in enrollment variable was significant.

AR1 and Each State Examined Individually

The results for AR1 were very similar to those for OLS. For most of the states, the coefficients of the income and price variables were significant. For about half the states, the coefficient of the state aid was significant. For less than half the states, the coefficient for the change in enrollment variable was significant.

B. Forecast Evaluation of the Barro Model

Mean absolute percentage errors (MAPEs) were calculated for each technique for producing forecasts to measure forecast accuracy. For the naive model, MAPEs were computed for the case in which current expenditures per pupil in constant dollars were assumed to increase throughout the forecast period at the average annual growth rate of the last three years. The MAPEs from each estimation/pooling technique were compared to the MAPEs from the naive model.

To produce the state MAPEs, for each estimation-pooling technique, a series of ex-post forecasts were calculated. This was done by excluding from one to five observations from the end of the sample. Then, forecasts were calculated using the parameter estimates and the actual values for the independent variables. This produced five one-year-out ex-post forecasts, four two-year-out ex-post forecasts, three three-year-out ex-post forecasts, two four-year-out ex-post forecasts, and one five-year-out ex-post forecast.

These ex-post forecasts were then compared to the actual values. In this paper, MAPEs were calculated as the primary measures of forecast accuracy. As up to five years were excluded from the sample period to produce the ex-post forecast, five different ex-post MAPEs were calculated. The one-year-out MAPE examines the accuracy of the five one-year-out forecasts, the two-year-out MAPE examines the accuracy of the four two-year-out forecasts and so forth.

The formula used to calculate the MAPE can be found in table 6.

The MAPE is one of several measures for forecast evaluation. Another standard measure is the root mean square error (rmse). These will not be examined since they were very similar to those for the MAPEs.

The Naive Model

First, we shall examine the MAPEs from the naive model. The naive model produced relatively low MAPEs for a large number of states (table 7). Forty-five states had a first-year-out MAPE of less than 5 percent and fifteen had a five-year-out MAPE of less than 5 percent. There were some states, however, that had quite large MAPEs, such as Louisiana.

Ordinary Least Squares and Data Pooled Nationally

The MAPEs were generally higher than those from the naive model. When compared to the naive model, only eight states had a lower one-year-out MAPE using this estimation of the Barro model. (See table 8 for the number of states which have a MAPE less than the naive model for each estimation/pooling technique.) The MAPEs for this estimation technique do not compare favorably to those calculated using the naive model.

Ordinary Least Squares, Data Pooled Regionally, and Dummy Variables

The results are mixed for this estimation/pooling technique. Only twenty-three states had one-year-out MAPEs less than those from the naive model. However, at least thirty-three states had MAPEs less than those of the naive model for each of the other forecast horizons.

Generalized Least Squares and Data Pooled Regionally

Unlike the case for the other estimation/pooling techniques, the ex-post MAPEs were generally lower than those from the naive model for the one-year-out MAPEs. Thirty-four states had one-year-out MAPEs which were smaller for this estimation of the Barro model than for the naive model. When this estimation/pooling technique was used, a majority of states had two-year-out through four-year-out MAPEs that were smaller than those from the naive model as well.

The results for the five-year-out MAPEs when generalized least squares was used are not directly comparable to those for the other estimation/pooling techniques. Generalized least squares could not be used to estimate the Barro model for the South Atlantic region due to a lack of observations. Hence, there are only 40 five-year-out MAPEs this estimation/pooling technique rather than 49.

Ordinary Least Squares and Each State Examined Individually

For twenty-one states, the one-year-out MAPEs for this estimation of the Barro model were lower than those of the naive model . However, for the two-year-out through the four-year-out time horizons, the MAPEs were lower than those of the naive model for at least thirty-one states.

AR1 and Each State Examined Individually

For eighteen states, the one-year-out MAPEs for this estimation were lower than those of the naive model. However, for at least thirty-four states, the two-year-out through five-year-out MAPEs were lower than those of the naive model.

C. Summary of the Results of the Barro Model

Results of the estimations of the Barro model showed that the estimated coefficients generally followed expectations no matter which estimation pooling technique was used. Also, the technique of breaking the states up into regions and using generalized least squares, performed best as a method for producing forecasts when using ex-post MAPEs were used as the criteria.

V. The Forecasting Model

There are problems with using the Barro model as previously estimated as a forecasting tool as not all the required data are available (table 9). First, there are no independently produced forecasts of the education price index used to adjust current expenditures so no current dollar projections could be produced. Second, there are no independently produced projections of the independent variable state and federal revenue receipts for education. To solve these difficulties, alternatives for the education price index and state and federal revenue receipts for education were found.

As a substitute for the education price index, the national consumer price index was used. The consumer price index has been used successfully with NCES's national education expenditures.

State and local tax payments were used as a substitute for state and federal revenue receipts for education. This variable acts as a measure of the general financial position of each state. It lacks any measure of the actions of federal government, but this may not be a major difficulty since federal aid for education makes up only a small portion of elementary and secondary education revenue.

The national forecasts for the consumer price index and the state forecasts of state and local government tax payments were provided by the economic forecasting firm, DRI/McGraw-Hill.

Hence, an alternative model, which will be called the Forecasting model, was developed using these substitutes. The alternative specifications for the different estimation/pooling techniques can be found in table 10.

The Forecasting model was estimated using the five estimation/pooling techniques used to estimate the Barro model. In presenting these results, there are two differences from the presentation of the Barro model. First, only statistically significant variables were included in the estimation of the Forecasting model presented here. The second difference only concerns the presentation of the case when each state was examined separately. Rather than presenting the results for both ordinary least squares and AR1 for each state, the results from only one estimation are presented for each state. The value of the Durbin-Watson test were used to determine which results should be presented. A summary of the differences between the Forecasting model and the Barro model can be found in table 11.

A. The Forecasting Model

Ordinary Least Squares and Data Pooled Nationally

Two variables that had been included in the estimation of the Barro model, the change in average daily attendance and the dummy variable for southern states, were excluded here because they were not statistically significant (table 12).

Ordinary Least Squares, Data Pooled Regionally, and Dummy Variables

The income variable was included in the estimations of all nine regions. The state aid variable was included in the estimations of seven of the regions and the price variable was included in the estimations of five of the regions. The change in enrollment variable was included in the estimation of only two regions (table 12).

Generalized Least Squares and Data Pooled Regionally

The income variable was included in the estimations of all nine regions. The state aid variable was included in the estimations of eight of the regions and the price variable was included in the estimations of seven of the regions. The change in enrollment variable was included in the estimation of only three regions (table 12).

Ordinary Least Squares/AR1 and Each State Examined Individually

While estimations were produced using both ordinary least squares and AR1, only one estimation is considered for each state. The Durbin-Watson statistics for each state were examined to chose which equation would be presented. For approximately two thirds of the states, the results of the AR1 estimation are presented.

In thirty-two equations, the income variable was included. In twenty-six equations, the aid variable was included. In thirty-one equations, the price variable was included. In twenty-two, the change in enrollment variable was included (table 12).

B. Forecast Evaluation of the Forecasting Model

As with the Barro model, ex-post MAPEs were compared to those from a naive model in which current expenditures per pupil in constant dollars was assumed to increase at the average annual growth rate of the last three years. These naive forecasts were different forecasts than those used to evaluate the alternative estimations of the Barro model because different price indexes were used with the dependent variable. Those MAPEs computed for the naive forecasts estimated using the consumer price index were higher than those estimated using the education price index for most states.

Ordinary Least Squares and Data Pooled Nationally

This specification does not do well when compared to the naive model (table 13). Only eight states had one-year-out MAPEs less than that from the naive model.

Ordinary Least Squares, Data Pooled Regionally, and Dummy Variables

The one-year-out MAPEs for this estimation/pooling technique were lower than those of the naive model for only eighteen states (table 13). However, the two-year-out MAPEs for this technique were lower for thirty-two states and the other types of MAPE were generally lower for this technique.

Generalized Least Squares and Data Pooled Regionally

As was the case with the Barro model, the MAPEs for this estimation/pooling technique (table 13) are generally lower than those of the other estimation/pooling techniques. Thirty-three states had one-year-out MAPEs less than the naive model and roughly forty states had two through four-year-out MAPEs less than the naive model.

Ordinary Least Squares/AR1 and Each State Examined Individually

Only sixteen states had one-year-out MAPEs lower than those of the naive model (table 13). For two through five-year-out periods, for most states, this estimation/pooling technique did do better than the naive model.

C. Summary of the Results of the Forecasting Model.

As with the estimations of the Barro model, the estimated coefficients of the Forecasting model generally followed expectations no matter which estimation pooling technique was used. Given the similarity of results between these two models for all the estimation/pooling techniques, the Forecasting model was used to produce the state forecasts.

Second, the technique of breaking the states up into regions and using generalized least squares, performed best as a method for producing forecasts when using ex-post MAPEs as the criteria. This superiority was strongest for the one-year-out MAPEs but also held for the two-year-out MAPEs, three-year-out MAPEs and four-year-out MAPEs as well.

D. Forecasting Models for Alaska and Hawaii

This paper analyzes models using a data base similar to Barro's which excluded two states, Alaska and Hawaii. In order to produce projections for the entire country, projections for those two states were needed. Two options were considered: 1) estimate equations for Alaska and Hawaii separately using either OLS or AR1; and 2) include the two states in their respective regions (the Pacific North West for Alaska and the Pacific South West for Hawaii) and re-estimate the model using the generalized least squares. In the end, the generalized least squares method for each of the states, including Alaska and Hawaii, was chosen to produce the state forecasts.

VI. Forecasts by State

A set of forecasts for current expenditures per pupil in average daily attendance for the fifty states and the District of Columbia were produced using the generalized least squares estimations. Those forecasts were multiplied by the unadjusted state forecasts for average daily attendance to produce the forecasts for total current expenditures. Both sets of projections are available in a data appendix which is available from the author.

A comparison of a forecast for the United States as a whole produced by summing up the state forecasts was compared with the national projections from both *Projections of Education Statistics to 2005* and *Projections of Education Statistics to 2007* (table 14). The projections produced by summing up the state projections were only slightly higher than the national figures from *Projections of Education Statistics to 2005*. (While the forecasts were produced in 1964-65 dollars, they are presented in this paper using 1992-93 dollars.)

If state projections are ever presented in the *Projections of Education Statistics*, the state projections will be adjusted by the same proportion so that the sum of the states projections equals the national projection. That same method was used here producing an adjusted set of state projections, equal to those in *Projections of Education Statistics to 2005*. *Projections of Education Statistics to 2005* had similar economic projections as used for the state forecasts in this paper. As the projections were produced so close in time, the state projections will be treated as if they had been produced with the *Projections of Education Statistics to 2005*. The adjusted current expenditure projections were divided by the adjusted projections for average daily attendance to produce adjusted projections for current expenditures per pupil in average daily attendance.

Average annualized growth rates for current expenditures for three different periods appear in table 15.

The period from 1980-81 to 1992-93 was a period in which current expenditures in constant dollars grew in all the states. The largest change was in Nevada which had an average annualized growth rate of 6.7 percent. The smallest was in Iowa, with an average annualized growth rate of 0.9 percent. In no region was an average annualized growth rate less than 2.0 percent and the nation as a whole had an average annualized growth rate of 3.0 percent.

For the nation as a whole and for most states, the average annualized growth rate for current expenditures was lower for the most recent historical period of 1989-90 to 1992-93, than for the entire historical period of 1980-81 to 1992-93. Seven states had negative average annualized growth rates over the recent historical period.

Current expenditures were forecast to increase for each state from 1992-93 to 1999-2000. The smallest increases were projected for Iowa and North Dakota with projected average annual growth rates of 1.0 percent and the greatest was projected for Massachusetts with a projected average annual growth rate of 4.6 percent. Regionally, the greatest increase was projected for the South-Atlantic region, which also had the greatest increase for the 1980-81 to 1992-93 period. The smallest increase was for the West-North-Central, which had the second lowest increase for the historical period.

For many states and the nation as a whole, one factor pushing up the total current expenditures projections was the increase in enrollment that was projected for the forecast period. The average growth rate for the historical period was only 0.4 percent. The projected average annual growth rate for average daily attendance was 1.7 percent. For each region, the projected average annualized growth rate was greater for the forecast period than for the historical period. While four regions had negative average annualized growth rates for the historical period, all regions had increases projected for the forecast period.

For the entire historical period, current expenditures per pupil had an average annualized growth rate of 2.6 percent (table 16) but there was considerable variation among regions and states. The Mid-Atlantic region had an average annualized growth rate of 3.6 percent, while the Pacific-South-West had one of 1.3 percent. Maine had the highest average annualized growth rate at 5.5 percent, while Alaska had the lowest at -0.6 percent.

The situation for the most recent historical period, from 1989-90 to 1992-93, was quite different than for the entire historical period. From 1989-90 to 1992-93, the average annualized growth rate was only 0.1 percent. The average annualized growth rate was negative for three regions and for about half the states.

For the nation as a whole, an average annualized growth rate of 1.5 percent was projected. The projected average annualized growth rate differs sharply by region. For five regions, an average annualized growth rate of 2.0 percent or greater was projected. For the Pacific-North-West an average annualized growth rate of only 1.0 percent was projected and for the Pacific-South-West an average annualized decrease of -0.3 percent was projected. The main cause of the negative number for the Pacific-South-West was the -0.8 percent average annualized growth rate projected for current expenditures per pupil in California.

VII. A Further Examination of the Forecasts

Given the potentially controversial role that state forecasts could have, care will be taken before any state projections are presented in an edition of the *Projections of Education Statistics*. This part of the paper presents the results of two additional tests of these projections.

A. Comparison with the 1993-94 Actual Values

NCES has published actual values for 1993-94. These values, in 1992-93 dollars, are compared with the adjusted projection (table 17).

Overall, the national projection from the *Projections of*

Education Statistics to 2005 was slightly higher (0.6%) that the actual value.

When we examine the regions, we see that for most regions the projections were quite close to the actual values. For six of the nine regions, the projection was within one percent of the actual value. The greatest difference was for the East North Central with a forecast 2.6 percent too large.

The results differed more widely by state. For about half the states, the projection was within 2 percent. However, there were seven states with projections off by greater than 4.0 percent. The states with the greatest differences were Ohio (8.8 percent) and North Dakota (12.1 percent).

B. Comparison with the Early Estimates

The 1994-95 and 1995-96 forecasts also were compared to the 1996 NCES Early Estimates. Each year NCES produces a series of early estimates for current expenditures. This edition of the early estimates, contains early estimates for 1994-95 and 1995-96. These numbers for the early estimates come from a survey of state education agencies. In some states, the state agencies may have a very good idea of what will be spent. With other states, the estimates may be significantly less accurate. Some states may not respond to the survey so NCES estimates a figure.

On table 18, there is a comparison of the early estimates with the projections for 1994-95 and 1995-96, all in 1992-93 dollars. As the early estimates are not final counts for each state, this comparison is not a test of the accuracy of the projections. Rather, rather it is a test to indicate if any states have any highly improbable projections.

If the early estimates and projections for a state differ sharply, this may mean one of several things. First, it could mean that this projections methodology had difficulty forecasting current expenditures for the state. Second, it could mean that there was a problem with the early estimate for that state. And third, it could mean that the early estimate has caught a change in the trend of that state which was beyond the ability of the forecasting model to capture.

For the national total, the early estimates and the projections produced similar numbers. For 1994-95, the projections were 1.5 percent greater than the early estimates and for 1995-96, they were 2.5 percent greater. While these national numbers were fairly close, there were significant differences at the state and regional levels.

For both 1994-95 and 1995-96, the projections of six of the nine regions were within 3 percent of the early estimates. For both years, the greatest difference between the early estimates and the projections was with the East-North-Central region. The early estimates showed virtually no change in that region while the projections showed relatively rapid rises. (It had the second highest increase of any of the regions.) Both alternatives are possible so it will take more data to see which, if either, is correct.

Greater differences between the early estimates and the projections were found when individual states were examined. For 1994-95, there were ten states for which the difference was 2 percent or less, and for 1995-96, there were eleven. On the other hand, for 1994-95 there were twenty-three states in which the difference was 5.0 percent or greater, and twenty-six states for 1995-96.

There were some states with very large differences. For the District of Columbia for 1995-96, the difference was 52.2 percent. This is caused by two very different futures for expenditures in 1995-96. The early estimates shows expenditures falling 33 percent from its 1993-94 level while the projections show current expenditures increasing 1.6 percent. Again both are plausible. It could be that there will be states for which the early estimates provide a better picture to the future and others for which it is the projections.

VIII. Conclusions and Directions for Future Research.

For the first time, NCES has produced a set of projections for current expenditures by state. These projections were produced using a model similar to that developed by Barro and was also similar to the model used to produce the national forecasts. Several alternative methods of estimating this model were examined. While each estimation/pooling method gave estimation coefficients that were usually of the expected sign and significant, the generalized least squares technique with the states broken up by region, proved to be the best technique for producing forecasts using as criteria a series of ex-post MAPEs. This technique was used to produce the forecasts of current expenditures by state.

For most states, and for the nation as a whole, the technique produced plausible projections of current expenditures. For each year in the forecast period, the sum of the state projections was quite close to the national projections presented in the *Projections of Education Statistics to 2005*.

Fairly rapid growth for current expenditures was projected for each state during the forecast period. Each state had a projected average annualized growth rates of at least one percent, and some states had rates greater than four percent.

Since enrollment is projected to grow during the forecast period, current expenditures per pupil were not projected to increase as rapidly, and were projected to fall in a couple states including California.

Two simple tests of the projections were conducted. In the first, the projections for 1993-94 were compared to the actual values for that year. In the second, the projections for 1994-95 and 1995-96 were compared to NCES Early Estimates. The second test was not a particularly strong test. It was more useful to pointing out highly implausible projections, and perhaps early estimates, which differ strongly from recent trends. As actual values for other years become available, forecasts for other years can be compared to other years as well. More tests for these projections and the early estimates will occur as more actual values are produced. Of special interest will be areas such as the East-North-Central in which the early estimates and forecasts differed sharply.

Given the potentially controversial nature of state expenditure projections, these preliminary projections should be compared to at least one more set of actual values for current expenditures, before consideration should be given to presenting state current expenditure projections in an edition of *Projections of Education Statistics*.

Until then, other work may be done on this model for forecasting current expenditures. One possible change could be the introduction of variables to measure if a state has had any court cases affecting the financing of education, or other legislative or policy variables.

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Table 1-Coefficients from the Barro paper

R-SQ	CONSTANT	PCI	TGRANT	ENROLLPOP	GRENROLL	LD	SOUTH	TGRANTS
0.850	218	0.20	1.15	-949	-372	34.4	-109	1.01
	12.1	24.9	9.7	-11.5	-6.5	5.4	-7.1	4.1

Where:

The dependent variable is current expenditures per student in 1965 dollars using an education price index;

PCI is income per capita in 1965 dollars;

TGRANT is the sum of revenue receipts from state sources and federal sources per capita in 1965 dollars;

ENROLLPOP is the ratio of enrollment to the population multiplied by the ratio of the education price index to the consumer price index;

GRENROLL is the change in enrollment;

LD is a dummy variable = 1 for population density less than 30;

SOUTH is a dummy variable = 1 for southern states; and

TGRANTS is a the product of TGRANT and the SOUTH variable;

Table 2- Alternate Methods for Estimating the Barro Model

Method 1.	Ordinary least squares and data pooled nationally
Method 2.	Ordinary least squares, data pooled regionally and dummy variables
Method 3.	Generalized least squares and data pooled regionally
Method 4.	Ordinary least squares with each state examined individually
Method 5.	AR1 with each state examined individually

Table 3- List of states by region

Region 1	New England	NENG
State 1	Connecticut	CT
State 2	Maine	ME
State 3	Massachusetts	MA
State 4	New Hamphire	NH
State 5	Rhode Island	RI
State 6	Vermont	VT
Region 2	Mid Atlantic	MATL
State 1	New Jersey	NJ
State 2	New York	NY
State 3	Pennsylvania	PA
Region 3	South Atlantic	SATL
State 1	Delaware	DE
State 2	District of Columbia	DC
State 3	Florida	FL
State 4	Georgia	GA
State 5	Maryland	MD
State 6	North Carolina	NC
State 7	South Carolina	SC
State 8	Virginia	VA
State 9	West Virginia	WV
Region 4	East South Central	ESC
State 1	Alabama	AL
State 2	Kentucky	KY
State 3	Mississippi	MS
State 4	Tennessee	TN
Region 5	West South Central	WSC
State 1	Arkansas	AR
State 2	Louisiana	LA
State 3	Oklahoma	OK
State 4	Texas	TX

Region 6	East North Central	ENC
State 1	Illinois	IL
State 2	Indiana	IN
State 3	Michigan	MI
State 4	Ohio	OH
State 5	Wisconsin	WI
Region 7	West South Central	WNC
State 1	Iowa	IA
State 2	Kansas	KS
State 3	Minnesota	MN
State 4	Missouri	MO
State 5	Nebraska	NE
State 6	North Dakota	ND
State 7	South Dakota	SD
Region 8	Pacific North West	PNW
State 1	Idaho	ID
State 2	Montana	MT
State 3	Oregon	OR
State 4	Washington	WA
State 5	Wyoming	WY
Region 9	Pacific South West	PSW
State 1	Arizona	AZ
State 2	California	CA
State 3	Colorado	CO
State 4	Nevada	NV
State 5	New Mexico	NM
State 6	Utah	UT

Table 4-Alternate specifications of the Barro model

Equation 1. Ordinary least squares and data pooled nationally

$$\text{LCUREXPE} = \beta_0 + \beta_1\text{LPCI} + \beta_2\text{LTGRANT} + \beta_3\text{LADAPOPE} + \beta_4\text{GRADA} + \beta_5\text{LD} + \beta_6\text{SOUTH} + \beta_7\text{LTGRANTS} + \mu$$

Equation 2. Ordinary least squares, data pooled regionally, and dummy variables

$$\text{LCUREXPE} = \beta_0 + \beta_1\text{LPCI} + \beta_2\text{LTGRANT} + \beta_3\text{LADAPOPE} + \beta_4\text{GRADA} + \alpha_1\text{DUMMY}_1 + \ldots\ldots + \alpha_N\text{DUMMY}_N + \mu$$

Equation 3. Generalized least squares and data pooled regionally

$$\text{LCUREXPE} = \beta_0 + \beta_1\text{LPCI} + \beta_2\text{LTGRANT} + \beta_3\text{LADAPOPE} + \beta_4\text{GRADA} + \mu$$

Equation 4. Ordinary least squares with each state examined individually

$$\text{LCUREXPE} = \beta_0 + \beta_1\text{LPCI} + \beta_2\text{LTGRANT} + \beta_3\text{LADAPOPE} + \beta_4\text{GRADA} + \mu$$

Equation 5. AR1 with each state examined individually

$$\text{LCUREXPE} = \beta_0 + \beta_1\text{LPCI} + \beta_2\text{LTGRANT} + \beta_3\text{LADAPOPE} + \beta_4\text{GRADA} + \mu$$

---

where:

LCUREXPE was current expenditures per student in ADA in 1965 dollars using the education price index in log form;

LPCI was disposable personal income per capita in 1965 dollars using the national price deflator for personal consumption expenditures in log form;

LTGRANT was the sum of revenue receipts from state sources and federal sources per capita in 1965 dollars using the national CPI in log form;

LADAPOPE was the ratio of average daily attendance to the population multiplied by ratio of the education price index to the national consumer price index in log form;

GRADA was the change in average daily attendance;

LD was a dummy variable measuring states with a population density greater than 30;

SOUTH was a dummy variable for southern states;

LTGRANTS was the product of LTGRANT and the SOUTH variable; and

DUMMY_i was a dummy variable equal to 1 for the ith state in alphabetical order in the region. There were dummy variables for each state in the region except the last one alphabetically.

Table 5 - Number of Regions/States in Which the Independent Variables Are Significant in the Estimations of the Barro Model

	LPCI	LTGRANT	LADAPOPE	GRADA	LD	SOUTH	LTGRANTS
OLS and Data Pooled Nationally	1	1	1	0	1	1	1
OLS, Data Pooled Regionally And Dummy Variables	8	7	5	2	--	--	--
GSL and Data Pooled Regionally	8	7	6	3	--	--	--
OLS and Each State Examined Individually	40	24	38	15	--	--	--
AR1 and Each State Examined Individually	40	26	41	13	--	--	--

Table 6- Formula to calculate the ith-year-out MAPE

$$MAPE_i = \Sigma \left[\left| 100(F_{ij} - A_{ij})/A_{ij} \right| \right]/n_i$$

where

$MAPE_i$ is the i-year-out MAPE,

n_i is the number of ex-post forecasts which are i years from the last actual value,

F_{ij} is the jth ex-post forecast which is i years from the last year in the sample period,

A_{ij} is the jth actual value which is i years from the last year in the sample period,

and

$j = 1,2,...,n_i$.

Table 7-Mean absolute percentage errors (MAPEs) of the naive model[1] using a Barro type education price index

NENG

STATE	CT	ME	MA	NH	RI	VT
1 Year Out MAPE	3.8%	3.5%	3.3%	3.7%	4.7%	5.0%
2 Year Out MAPE	9.9%	6.4%	7.9%	7.8%	6.7%	9.3%
3 Year Out MAPE	18.5%	14.3%	16.0%	13.6%	11.0%	16.1%
4 Year Out MAPE	23.9%	16.5%	26.4%	19.8%	14.1%	22.2%
5 Year Out MAPE	19.5%	20.1%	33.3%	28.1%	6.9%	36.5%

MATL

STATE	NJ	NY	PA
1 Year Out MAPE	2.5%	2.7%	3.7%
2 Year Out MAPE	5.6%	5.8%	8.4%
3 Year Out MAPE	9.3%	10.3%	11.5%
4 Year Out MAPE	16.1%	16.9%	9.4%
5 Year Out MAPE	26.5%	20.8%	7.9%

SATL

STATE	DE	DC	FL	GA	MD	NC	SC	VA	WV
1 Year Out MAPE	1.2%	8.9%	3.1%	3.5%	2.5%	3.6%	1.9%	2.8%	4.6%
2 Year Out MAPE	1.6%	19.4%	7.9%	6.4%	5.6%	7.9%	3.9%	7.5%	5.7%
3 Year Out MAPE	2.7%	26.4%	10.4%	8.4%	7.8%	10.1%	4.2%	13.2%	11.7%
4 Year Out MAPE	4.1%	27.3%	11.6%	10.8%	10.8%	8.0%	1.6%	22.9%	13.8%
5 Year Out MAPE	4.8%	14.4%	10.0%	8.8%	9.6%	3.7%	0.0%	27.3%	9.8%

ESC

STATE	AL	KY	MS	TN
1 Year Out MAPE	4.8%	3.9%	4.1%	6.1%
2 Year Out MAPE	7.6%	6.2%	8.0%	8.2%
3 Year Out MAPE	10.1%	6.8%	11.2%	14.8%
4 Year Out MAPE	9.7%	7.4%	9.9%	20.2%
5 Year Out MAPE	9.3%	12.1%	16.5%	13.2%

WSC

STATE	AR	LA	OK	TX
1 Year Out MAPE	2.6%	5.2%	2.9%	1.3%
2 Year Out MAPE	1.8%	10.9%	6.1%	2.3%
3 Year Out MAPE	1.8%	15.5%	12.1%	3.6%
4 Year Out MAPE	4.0%	23.5%	16.6%	3.4%
5 Year Out MAPE	4.3%	25.6%	21.2%	4.9%

(Footnotes appear at the end of the table.)

Table 7-Mean absolute percentage errors (MAPEs) of the naive model[1] using a Barro type education price index
(Continued)

ENC

STATE	IL	IN	MI	OH	WI
1 Year Out MAPE	2.7%	2.7%	1.5%	4.2%	1.9%
2 Year Out MAPE	3.6%	4.1%	1.7%	6.4%	1.8%
3 Year Out MAPE	5.4%	5.7%	2.1%	8.4%	3.2%
4 Year Out MAPE	7.8%	6.4%	2.8%	10.4%	5.3%
5 Year Out MAPE	1.9%	1.2%	2.7%	10.6%	2.2%

WNC

STATE	IA	KS	MN	MO	NE	ND	SD
1 Year Out MAPE	2.5%	3.1%	1.2%	3.4%	3.7%	4.0%	2.0%
2 Year Out MAPE	5.1%	4.1%	1.6%	6.8%	6.1%	5.8%	2.3%
3 Year Out MAPE	3.8%	2.1%	2.7%	11.5%	7.8%	5.9%	2.9%
4 Year Out MAPE	0.8%	3.3%	4.3%	16.4%	6.8%	8.2%	5.4%
5 Year Out MAPE	1.4%	9.1%	2.7%	13.2%	11.5%	18.7%	12.4%

PNW[2]

STATE	ID	MT	OR	WA	WY
1 Year Out MAPE	2.3%	4.1%	2.4%	1.5%	1.9%
2 Year Out MAPE	5.1%	6.9%	4.4%	3.7%	2.1%
3 Year Out MAPE	8.4%	10.3%	6.2%	6.3%	3.4%
4 Year Out MAPE	11.9%	13.9%	6.9%	10.5%	5.9%
5 Year Out MAPE	14.3%	10.7%	4.2%	13.6%	8.5%

PSW[2]

STATE	AZ	CA	CO	NV	NM	UT
1 Year Out MAPE	1.7%	2.0%	2.1%	2.6%	6.8%	1.9%
2 Year Out MAPE	2.6%	1.7%	3.0%	6.1%	9.2%	3.6%
3 Year Out MAPE	4.8%	2.1%	1.8%	6.6%	10.3%	7.0%
4 Year Out MAPE	8.5%	1.8%	2.7%	7.1%	13.4%	10.3%
5 Year Out MAPE	15.7%	2.4%	0.9%	4.6%	14.1%	11.7%

---

[1] Forecasts were developed for the naive model by using the average annual growth rate of the last three years. See the text for more details.

[2] MAPEs are not presented for Alaska and Hawaii.

Table 8-Number of states which have a mean absolute percentage error (MAPE)less than that from the naive model[1] using a Barro type education price index for each estimation/pooling technique using the Barro model[2]

MAPEs using ordinary least squares and data pooled nationally[3]

1 Year Out MAPE	8
2 Year Out MAPE	17
3 Year Out MAPE	21
4 Year Out MAPE	23
5 Year Out MAPE	22

MAPEs using ordinary least squares, data pooled regionally, and dummy variables[3]

1 Year Out MAPE	23
2 Year Out MAPE	34
3 Year Out MAPE	36
4 Year Out MAPE	36
5 Year Out MAPE	33

MAPEs using generalized least squares and data pooled regionally[3]

1 Year Out MAPE	34
2 Year Out MAPE	36
3 Year Out MAPE	38
4 Year Out MAPE	40
5 Year Out MAPE	27 [4]

MAPEs using ordinary least squares for each state examined individually[3]

1 Year Out MAPE	21
2 Year Out MAPE	31
3 Year Out MAPE	34
4 Year Out MAPE	36
5 Year Out MAPE	34

MAPEs using AR1 for each state examined individually[3]

1 Year Out MAPE	18
2 Year Out MAPE	34
3 Year Out MAPE	36
4 Year Out MAPE	35
5 Year Out MAPE	34

---

[1] Forecasts were developed for the naive model by using the average annual growth rate of the last three years. See the text for more details.

[2] See table 4 for a summary of the Barro. Only statistically significant variables were included in these estimations.

[3] Alaska and Hawaii were not included in the samples so MAPEs were not calculated for those states.

[4] Due to a lack of degrees of freedom, generalized least squares was not used for the South Atlantic region when five years were omitted.

Table 9- Data Requirements for Forecasting the Barro Model by State

	Are Forecasts Available?	Substitute If Needed
Personal Disposable Income	Yes	---
Population	Yes	---
National Price Deflator for Consumption Expenditures	Yes	---
National Consumer Price Index	Yes	---
Average Daily Attendance	Yes[1]	---
Sum of Revenue Receipts from State and Federal Sources	No	Sum of State and Local Tax Tax Payments
National Education Price Index	No	National Consumer Price Index

---

[1] Average daily attendance forecasts computed using the state forecasts for fall enrollment.

Table 10- Alternate specifications of the Forecasting model

Equation 1. Ordinary least squares and data pooled nationally

$$\begin{aligned} LCUREXPC = {} & \beta_0 + \beta_1 LPCI + \beta_2 LTPSL + \beta_3 LADAPOP \\ & + \beta_4 GRADA + \beta_5 LD + \beta_6 SOUTH + \beta_7 LTPSLS + \mu \end{aligned}$$

Equation 2. Ordinary least squares, data pooled regionally, and dummy variables

$$\begin{aligned} LCUREXPC = {} & \beta_0 + \beta_1 LPCI + \beta_2 LTPSL + \beta_3 LADAPOP + \beta_4 GRADA \\ & + \alpha_1 DUMMY_1 + \ldots\ldots + \alpha_N DUMMY_N + \mu \end{aligned}$$

Equation 3. Generalized least squares data pooled regionally

$$LCUREXPC = \beta_0 + \beta_1 LPCI + \beta_2 LTPSL + \beta_3 LADAPOP + \beta_4 GRADA + \mu$$

Equation 4. Ordinary least squares with each state examined individually

$$LCUREXPC = \beta_0 + \beta_1 LPCI + \beta_2 LTPSL + \beta_3 LADAPOP + \beta_4 GRADA + \mu$$

Equation 5. AR1 with each state examined individually

$$LCUREXPC = \beta_0 + \beta_1 LPCI + \beta_2 LTPSL + \beta_3 LADAPOP + \beta_4 GRADA + \mu$$

Where:

LCUREXPC was current expenditures per student in ADA in 1965 dollars using the national consumer price index in log form;

LPCI was disposable personal income per capita in 1965 dollars using the national price deflator for personal consumption expenditures in log form;

LTPSL was the sum of state and local tax payments per capita in 1965 dollars using the national CPI in log form;

LADAPOP was the ratio of average daily attendance to the population;

GRADA was the change in average daily attendance;

LD was a dummy variable measuring states with a population density greater than 30;

SOUTH was a dummy variable for southern states;

LTPSLS was the product of LTPSL and the SOUTH variable; and

$DUMMY_i$ was a dummy variable equal to 1 for the ith state in alphabetical order in the region. There were dummy variables for each state in the region except the last one alphabetically.

Table 11-Comparison of the Barro model and the Forecasting model

	Barro Model	Forecasting Model
	Differences in the Models	
Price deflator for dependent variable	Education price deflator[1]	National consumer price index
State variable	Sum of revenue receipts from state and federal sources per capita in 1965 dollars using the national CPI in log form	Sum of state and local tax payments per capita in 1965 using the national CPI in log form
Price variable	Ratio of the average daily attendance to the population multiplied by ratio of the education price index[1] to the national consumer price index in log form	Ratio of the average daily attendance to the population in log form
	Differences in the Estimations of the Models	
Estimation includes statistically insignficant variables	Yes	No[2]
Results for both Ordinary Least Squares and AR1 presented for case when states examined seperately	Yes	No

---

[1] Definition of the education price index is presented in the text.

[2] Statistically insignificant state dummy variables were included in estimations.

Table 12- Number of Regions/States in which the Independent Variables are Present in the Estimations of the Forecasting Model

	LPCI	LTPSL	LADAPOP	GRADA	LD	SOUTH	LTPSLS
OLS and Data Pooled Nationally	1	1	1	0	1	0	1
OLS, Data Pooled Regionally And Dummy Variables	9	7	5	2	--	--	--
GSL and Data Pooled Regionally	9	8	7	3	--	--	--
OLS/AR1 and Each State Examined Individually	32	26	31	22	--	--	--

Table 13-Number of states which have a MAPE less than that from the naive model[1] for each estimation/pooling technique using the consumer price index for each estimation/pooling technique using the Forecasting model[2]

MAPEs using ordinary least squares and data pooled nationally[3]

1 Year Out MAPE	8
2 Year Out MAPE	20
3 Year Out MAPE	29
4 Year Out MAPE	30
5 Year Out MAPE	31

MAPEs using ordinary least squares, data pooled regionally, and dummy variables[3]

1 Year Out MAPE	18
2 Year Out MAPE	32
3 Year Out MAPE	35
4 Year Out MAPE	38
5 Year Out MAPE	38

MAPEs using generalized least squares and data pooled regionally- Alaska and Hawaii not in the samples[3]

1 Year Out MAPE	33
2 Year Out MAPE	40
3 Year Out MAPE	41
4 Year Out MAPE	40
5 Year Out MAPE	26 [4]

MAPEs using generalized least squares and data pooled regionally- Alaska and Hawaii in the samples[5]

1 Year Out MAPE	33
2 Year Out MAPE	41
3 Year Out MAPE	40
4 Year Out MAPE	40
5 Year Out MAPE	28 [4]

MAPEs using ordinary least squares or AR1 with states examined individually[5]

1 Year Out MAPE	16
2 Year Out MAPE	35
3 Year Out MAPE	37
4 Year Out MAPE	38
5 Year Out MAPE	38

---

[1] Forecast were developed for the naive model by using the average annual growth rate of the last three years. See the text for more details.

[2] See table 10 for a summary of the Forecasting model. Only statistically significant variables were included in these estimations.

[3] Alaska and Hawaii were not included in the samples so MAPEs were not calculated for those states.

[4] Due to a lack of degrees of freedom, generalized least squares was not used for the South Atlantic region when five years were omitted.

[5] Alaska and Hawaii were included in the samples yet those MAPEs were not included in this count.

Table 14-Current expenditures and current expenditures per pupil in average daily attendance (both in constant 1992-93 dollars[1]): actual values for 1980-81 through 1993-94; projections from *Projections of Education Statistics to 2007* for 1994-95 to 1999-2000; projections from *Projections of Education Statistics to 2005* for 1993-94 to 1999-2000; and the sum of state projections[2] for 1993-94 to 1999-2000.

	Total current expenditures in billions in constant 1992-93 dollars			Current expenditures per pupil in constant 1992-93 dollars		
Year ending	Actual Values and Projections from *Projections of Education Statistics to 2007*	Projections from *Projections of Education Statistics to 2005*	Sum of the state projections	Actual Values and Projections from *Projections of Education Statistics to 2007*	Projections from *Projections of Education Statistics to 2005*	Sum of the state projections
1982	$153.1			$4,128		
1983	157.3			4,293		
1984	161.6			4,445		
1985	170.3			4,678		
1986	179.7			4,919		
1987	187.5			5,087		
1988	193.2			5,215		
1989	203.6			5,463		
1990	211.0			5,581		
1991	215.0			5,595		
1992	217.8			5,591		
1993 [3]	220.9	$220.8		5,584	$5,566	
1994 [4]	225.6	227.0	$227.8	5,620	5,630	$5,641
				Projections		
1995	231.3	234.5	237.6	5,652	5,712	5,781
1996	237.6	242.1	243.7	5,703	5,794	5,824
1997	243.7	251.2	251.1	5,749	5,891	5,879
1998	250.4	260.6	259.3	5,824	6,001	5,963
1999	256.2	269.1	266.1	5,901	6,118	6,038
2000	263.4	276.6	272.5	6,018	6,222	6,119

[1] Based on the Consumer Price Index for all urban consumers, Bureau of Labor Statistics, U.S. Department of Labor.

[2] The sum of state projections was not adjusted.

[3] The value from *Projections of Education Statistics to 2005* is a projection

[4] The values from *Projections of Education Statistics to 2005* and the sum of state projections are projections

Table 15-Average annualized percent change of current expenditures[1] in constant dollars[2] by state and region: 1980-81 to 1992-93; 1989-90 to 1992-93; and 1992-93 to 1999-2000

	Average annualized percentage change		
	From 1980-81 to 1992-93	From 1989-90 to 1992-93	From 1992-93 to 1999-2000
US	3.0%	1.7%	3.2%
NENG	2.8%	0.2%	3.2%
CT	3.9%	-0.1%	2.3%
ME	5.2%	1.1%	1.4%
MA	1.2%	-0.4%	4.6%
NH	4.7%	1.8%	2.5%
RI	3.1%	1.9%	1.7%
VT	4.5%	0.6%	1.7%
MATL	3.0%	1.5%	3.3%
NJ	4.3%	3.5%	2.8%
NY	2.7%	1.0%	3.4%
PA	2.5%	0.9%	3.6%
SATL	4.0%	1.4%	4.0%
DE	2.5%	1.5%	3.1%
DC	2.7%	-1.9%	2.4%
FL	4.8%	1.5%	4.8%
GA	5.5%	2.1%	4.4%
MD	3.0%	1.8%	3.4%
NC	3.0%	0.8%	4.2%
SC	4.1%	1.0%	2.8%
VA	3.7%	0.7%	3.7%
WV	2.3%	3.2%	2.8%
ESC	2.4%	1.6%	2.9%
AL	1.1%	0.7%	3.5%
KY	3.8%	6.3%	1.7%
MS	2.6%	-1.1%	2.4%
TN	2.4%	0.1%	3.6%
WSC	3.5%	2.0%	3.8%
AR	3.2%	2.6%	4.5%
LA	0.8%	0.6%	4.1%
OK	1.8%	4.5%	3.8%
TX	4.7%	1.8%	3.6%

(Footnotes appear at the end of the table.)

Table 15-Average annualized percent change of current expenditures[1] in constant dollars[2] by state and region: 1980-81 to 1992-93; 1989-90 to 1992-93; and 1992-93 to 1999-2000 (Continued)

	Average annualized percentage change		
	From 1980-81 to 1992-93	From 1989-90 to 1992-93	From 1992-93 to 1999-2000
ENC	2.2%	2.5%	3.3%
IL	2.0%	2.9%	3.6%
IN	3.6%	2.0%	3.0%
MI	0.9%	1.9%	3.3%
OH	2.9%	2.2%	3.3%
WI	3.3%	3.9%	2.8%
WNC	2.3%	1.6%	1.9%
IA	0.9%	3.0%	1.0%
KS	2.9%	2.3%	1.6%
MN	2.4%	2.0%	2.4%
MO	2.7%	0.2%	2.4%
NE	2.7%	1.1%	1.5%
ND	1.6%	-0.5%	1.0%
SD	2.8%	3.3%	2.5%
PNW	2.9%	3.9%	3.2%
AK	1.8%	1.4%	1.3%
ID	2.7%	4.5%	3.6%
MT	1.9%	2.9%	2.6%
OR	2.5%	3.4%	3.5%
WA	3.9%	5.5%	3.5%
WY	1.7%	-1.4%	2.0%
PSW	3.3%	1.1%	2.6%
AZ	3.8%	2.8%	3.5%
CA	3.3%	0.1%	2.5%
CO	2.2%	2.0%	2.7%
HI	3.2%	6.4%	1.7%
NV	6.7%	9.0%	4.1%
NM	2.5%	2.7%	2.4%
UT	3.0%	2.8%	3.1%

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[1] State current expenditures projections were adjusted so that the sum of state projections equaled the national projections from *Projections of Education Statistics to 2005*.

[2] Based on the Consumer Price Index for all urban consumers, Bureau of Labor Statistics, U.S. Department of Labor.

Table 16-Average annualized percent change of current expenditures[1] per pupil in average daily attendence in constant dollars[2] by state and region: 1980-81 to 1992-93; 1989-90 to 1992-93; and 1992-93 to 1999-2000

	Average annualized percentage change		
	From 1980-81 to 1992-93	From 1989-90 to 1992-93	From 1992-93 to 1999-2000
US	2.6%	0.1%	1.5%
NENG	3.5%	-1.6%	2.0%
CT	4.4%	-2.2%	0.9%
ME	5.5%	0.2%	1.2%
MA	2.7%	-1.8%	3.3%
NH	3.5%	-1.8%	1.6%
RI	3.1%	-0.4%	0.6%
VT	4.2%	-1.5%	1.0%
MATL	3.6%	0.0%	1.8%
NJ	4.8%	1.7%	0.9%
NY	3.1%	-0.5%	2.0%
PA	3.3%	-0.5%	2.3%
SATL	3.2%	-0.6%	2.0%
DE	2.0%	-0.6%	1.0%
DC	4.3%	-1.8%	3.9%
FL	2.5%	-1.8%	2.1%
GA	4.3%	-0.1%	2.2%
MD	3.0%	-0.6%	0.8%
NC	3.1%	0.1%	2.0%
SC	4.1%	0.3%	1.3%
VA	2.8%	-1.3%	2.3%
WV	3.8%	4.1%	3.3%
ESC	2.5%	1.1%	2.0%
AL	1.2%	0.2%	2.5%
KY	4.3%	5.7%	1.2%
MS	2.1%	-0.9%	2.2%
TN	2.5%	-1.0%	2.1%
WSC	2.4%	0.7%	2.5%
AR	3.3%	1.8%	3.7%
LA	0.7%	0.8%	3.9%
OK	1.6%	3.4%	3.2%
TX	2.9%	0.1%	1.9%

(Footnotes appear at the end of the table.)

Table 16-Average annualized percent change of current expenditures[1] per pupil in average daily attendence in constant dollars[2] by state and region: 1980-81 to 1992-93; 1989-90 to 1992-93; and 1992-93 to 1999-2000
(Continued)

	Average annualized percentage change		
	From 1980-81 to 1992-93	From 1989-90 to 1992-93	From 1992-93 to 1999-2000
ENC	3.0%	1.4%	2.3%
IL	2.4%	0.9%	2.8%
IN	4.1%	1.5%	2.3%
MI	2.2%	1.4%	2.0%
OH	3.9%	2.0%	2.3%
WI	3.1%	1.5%	1.8%
WNC	2.1%	0.0%	1.1%
IA	1.5%	1.7%	0.7%
KS	2.2%	0.7%	0.5%
MN	2.0%	-0.2%	1.1%
MO	2.6%	-1.2%	1.5%
NE	2.6%	-0.6%	0.9%
ND	1.7%	-0.9%	1.5%
SD	2.4%	1.3%	1.5%
PNW	1.8%	1.0%	1.0%
AK	-0.6%	-2.6%	-1.2%
ID	1.6%	2.2%	2.0%
MT	1.7%	0.7%	1.6%
OR	1.8%	0.8%	1.4%
WA	2.5%	2.1%	0.7%
WY	1.5%	-2.4%	1.8%
PSW	1.3%	-0.6%	-0.3%
AZ	1.6%	-0.3%	0.5%
CA	1.3%	-1.0%	-0.8%
CO	1.2%	-1.0%	0.6%
HI	2.4%	4.5%	-0.4%
NV	3.3%	3.1%	0.2%
NM	0.5%	1.1%	0.7%
UT	0.5%	0.8%	2.1%

---

[1] State current expenditures projections were adjusted so that the sum of state projections equaled the national projections from *Projections of Education Statistics to 2005*.

[2] Based on the Consumer Price Index for all urban consumers, Bureau of Labor Statistics, U.S. Department of Labor.

Table 17-Current expenditures[1] in billions of constant 1992-93 dollars[2] by state and region; 1992-93 actual values: 1993-94 actual values; 1993-94 projections; and percentage differences between 1993-94 actual values and projections

	1992-93 Actual values	1993-94 Actual values	1993-94 Projections	Percentage differences between 1993-94 actual values and 1993-94 projections
	Billions of 1992-93 dollars			Percent
US	$220.9	$225.6	$227.0	0.6%
NENG	12.8	13.1	13.0	-0.7%
CT	3.7	3.8	3.8	-1.7%
ME	1.2	1.2	1.2	3.4%
MA	5.3	5.5	5.5	0.7%
NH	1.0	1.0	0.9	-6.5%
RI	0.9	1.0	0.9	-4.4%
VT	0.6	0.6	0.6	1.1%
MATL	41.8	42.6	42.8	0.4%
NJ	9.9	10.2	9.8	-3.7%
NY	20.9	21.5	21.6	0.7%
PA	10.9	11.0	11.3	3.6%
SATL	35.2	36.2	36.4	0.5%
DE	0.6	0.6	0.6	-2.6%
DC	0.7	0.7	0.7	-1.6%
FL	9.7	10.1	10.1	-0.1%
GA	5.3	5.5	5.5	-0.1%
MD	4.6	4.7	4.6	-0.4%
NC	4.9	5.0	5.1	2.7%
SC	2.7	2.7	2.7	0.6%
VA	5.2	5.3	5.4	1.2%
WV	1.6	1.6	1.7	2.2%
ESC	10.2	10.5	10.5	-0.2%
AL	2.6	2.7	2.7	-0.7%
KY	2.8	2.9	2.8	-1.1%
MS	1.6	1.7	1.6	-2.2%
TN	3.1	3.2	3.3	2.0%
WSC	22.5	23.3	22.9	-1.7%
AR	1.7	1.7	1.7	0.3%
LA	3.2	3.2	3.3	1.8%
OK	2.4	2.6	2.5	-4.1%
TX	15.1	15.8	15.4	-2.3%

(Footnotes appear at the end of the table.)

Table 17-Current expenditures[1] in billions of constant 1992-93 dollars[2] by state and region; 1992-93 actual values: 1993-94 actual values; 1993-94 projections; and percentage differences between 1993-94 actual values and projections
(Continued)

	1992-93 Actual values	1993-94 Actual values	1993-94 Projections	Percentage differences between 1993-94 actual values and 1993-94 projections
	Billions of 1992-93 dollars			Percent
ENC	$38.4	$38.7	$39.8	2.6%
IL	9.9	9.8	9.9	1.3%
IN	4.8	4.9	4.8	-2.8%
MI	9.5	9.6	9.8	2.8%
OH	9.2	9.4	10.2	8.8%
WI	5.0	5.0	5.0	-1.0%
WNC	15.0	15.4	15.4	0.3%
IA	2.5	2.5	2.4	-3.7%
KS	2.2	2.3	2.2	-2.5%
MN	4.1	4.2	4.3	2.8%
MO	3.7	3.9	4.0	2.9%
NE	1.4	1.5	1.4	-6.5%
ND	0.5	0.5	0.5	-2.0%
SD	0.6	0.6	0.6	12.1%
PNW	10.6	10.7	10.9	1.8%
AK	1.0	1.0	1.0	-0.9%
ID	0.8	0.8	0.8	0.7%
MT	0.8	0.8	0.8	1.3%
OR	2.8	2.8	2.9	5.7%
WA	4.7	4.8	4.8	0.4%
WY	0.5	0.5	0.6	2.5%
PSW	34.5	35.0	35.3	0.8%
AZ	2.8	2.8	2.9	2.3%
CA	24.2	24.5	24.7	0.8%
CO	2.9	2.9	3.0	3.3%
HI	0.9	1.0	0.9	-3.1%
NV	1.0	1.1	1.1	1.9%
NM	1.2	1.3	1.3	-1.5%
UT	1.4	1.5	1.4	-3.7%

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[1] State current expenditures projections were adjusted so that the sum of the state projections equaled the national projections from *Projections of Education Statistics to 2005*.

[2] Based on the Consumer Price Index for all urban consumers, Bureau of Labor Statistics, U.S. Department of Labor.

Table 18-Current expenditures[1] in billions of constant 1992-93 dollars[2] by state and region: 1994-95 early estimates; 1994-95 projections; percentage differences between 1994-95 early estimates and projections, 1995-96 early estimates; 1995-96 projections; and percentage differences between 1995-96 early estimates and projections

	1994-95 Early estimates	1994-95 Projections	Percentage differences between 1994-95 early estimates and 1994-95 projections	1995-96 Early estimates	1995-96 Projections	Percentage differences between 1995-96 early estimates and 1995-96 projections
	Billions of 1992-93 dollars		Percent	Billions of 1992-93 dollars		Percent
US	$231.1	$234.5	1.5%	$236.3	$242.1	2.5%
NENG	13.2	13.6	2.7%	13.5	14.0	3.4%
CT	3.7	3.9	4.3%	3.8	4.0	4.7%
ME	1.2	1.2	5.3%	1.2	1.3	6.3%
MA	5.6	5.9	4.9%	5.8	6.2	6.0%
NH	1.1	1.0	-8.9%	1.1	1.0	-8.7%
RI	1.0	0.9	-3.5%	1.0	1.0	-5.7%
VT	0.6	0.6	-0.9%	0.6	0.6	2.7%
MATL	43.9	44.4	1.2%	45.4	45.7	0.7%
NJ	10.4	10.1	-2.3%	10.8	10.4	-3.4%
NY	22.1	22.4	1.6%	22.7	23.0	1.5%
PA	11.4	11.8	3.5%	11.9	12.2	2.7%
SATL	37.2	37.8	1.6%	38.2	39.3	2.9%
DE	0.7	0.6	-6.3%	0.7	0.7	-5.8%
DC	0.6	0.7	23.3%	0.5	0.7	52.2%
FL	10.4	10.6	1.1%	10.8	11.0	1.5%
GA	5.5	5.8	4.2%	5.8	6.0	4.5%
MD	4.6	4.8	4.4%	4.8	5.0	2.8%
NC	5.7	5.4	-5.9%	5.6	5.6	-1.0%
SC	2.7	2.8	3.7%	2.7	2.9	5.3%
VA	5.3	5.5	3.3%	5.5	5.7	4.5%
WV	1.7	1.7	0.8%	1.7	1.7	1.7%
ESC	11.4	10.8	-5.9%	11.6	11.1	-4.7%
AL	2.9	2.8	-2.1%	2.9	2.9	0.3%
KY	3.3	2.9	-12.4%	3.4	3.0	-12.7%
MS	1.8	1.7	-8.4%	1.9	1.7	-8.2%
TN	3.4	3.4	-1.5%	3.5	3.5	0.9%
WSC	24.2	23.7	-1.8%	24.6	24.6	0.2%
AR	1.4	1.8	36.3%	1.4	1.9	40.7%
LA	3.2	3.4	6.6%	3.2	3.6	11.2%
OK	2.2	2.6	15.8%	2.1	2.7	24.0%
TX	17.4	15.9	-8.6%	17.8	16.4	-7.8%

(Footnotes appear at the end of the table.)

Table 18-Current expenditures[1] in billions of constant 1992-93 dollars[2] by state and region: 1994-95 early estimates; 1994-95 projections; percentage differences between 1994-95 early estimates and projections; 1995-96 early estimates; 1995-96 projections; and percentage differences between 1995-96 early estimates and projections (Continued)

	1994-95 Early estimates	1994-95 Projections	Percentage differences between 1994-95 early estimates and 1994-95 projections	1995-96 Early estimates	1995-96 Projections	Percentage differences between 1995-96 early estimates and 1995-96 projections
	Billions of 1992-93 dollars		Percent	Billions of 1992-93 dollars		Percent
ENC	$38.5	$41.6	8.1%	$38.9	$43.0	10.3%
IL	9.6	10.4	8.7%	9.6	10.9	13.1%
IN	5.1	5.0	-2.5%	5.2	5.1	-2.2%
MI	9.3	10.5	12.7%	9.3	10.8	15.1%
OH	9.3	10.5	12.2%	9.5	10.8	14.0%
WI	5.2	5.3	1.5%	5.3	5.4	2.5%
WNC	16.3	15.4	-5.4%	16.3	15.9	-2.3%
IA	2.5	2.5	-0.1%	2.5	2.5	-0.3%
KS	2.3	2.2	-4.3%	2.4	2.3	-4.7%
MN	5.4	4.4	-17.5%	5.3	4.6	-14.6%
MO	3.7	3.8	4.1%	3.6	4.0	12.3%
NE	1.4	1.4	5.4%	1.4	1.5	7.1%
ND	0.5	0.5	-1.9%	0.5	0.5	1.3%
SD	0.6	0.5	-9.0%	0.6	0.6	-2.0%
PNW	11.2	11.3	0.4%	11.3	11.6	2.5%
AK	1.1	1.0	-9.9%	1.1	1.0	-8.5%
ID	0.9	0.9	-6.3%	1.0	0.9	-5.6%
MT	0.8	0.8	-2.6%	0.8	0.8	0.9%
OR	2.7	3.1	12.1%	2.8	3.2	13.5%
WA	5.1	5.0	-2.2%	5.1	5.2	0.1%
WY	0.6	0.6	2.3%	0.5	0.6	7.8%
PSW	35.1	35.9	2.3%	36.4	36.9	1.5%
AZ	2.9	3.0	0.3%	3.1	3.1	-1.5%
CA	24.1	25.1	4.2%	24.7	25.7	3.7%
CO	3.1	3.1	-1.2%	3.1	3.1	2.3%
HI	0.8	0.9	22.8%	0.7	0.9	27.5%
NV	1.1	1.1	4.1%	1.2	1.2	3.5%
NM	1.6	1.3	-19.5%	1.9	1.3	-29.9%
UT	1.5	1.5	-5.4%	1.6	1.5	-5.9%

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[1] State current expenditures projections were adjusted so that the sum of the state projections equaled the national projections from *Projections of Education Statistics to 2005*.

[2] Based on the Consumer Price Index for all urban consumers, Bureau of Labor Statistics, U.S. Department of Labor.

MEDICAID FORECASTING PRACTICES[1]

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COMPARING MEDICAID FORECASTS

Applied forecasting literature includes numerous studies in which different approaches are compared through simulated forecasting such as the M-competition, the M-2 Competition, and the M-3 Competition (Makridakis, *et. al.*, 1982; Makridakis *et. al.*, 1989; Hibon and Makridakis, 1997). Less frequently, studies compare different actual forecasts of the same data series (Ashley, 1988); however, because of the small number of such multiple forecasts, there is limited opportunity to evaluate sources of variation.

State government forecasting provides an opportunity for studying a large number of forecasts of similar series to determine the effects of different variables on forecasting practice. Often, many states forecast similar series, such as tax revenue, nursing home bed need, prison population, or educational enrollment. While some characteristics of these series differ from state to state other characteristics may be similar. For example, the unit of analysis may be similar between states – each state might be interested in dollars of revenue, a count of children at each age cohort, and so forth. Also, the series in each state may experience the similar social and political perturbances at about the same time. The study of these such forecasts may provide insight about variables that affect applied forecasting.

This paper examines forecasting activities among Medicaid agencies in the fifty United States, Washington, D.C., and five U.S. territories (American Samoa, Guam, Puerto Rico, Northern Mariana Islands, and Virgin Islands). Most frequently, studies of state or local forecasting practice focus on revenue forecasting (Rodgers and Joyce, 1996; Bretschneider and Schroeder, 1988; Bretschneider. *et. al.*, 1989). There are several reasons why comparison of state Medicaid forecast practice may be better than comparison of state revenue forecasting practices. First, there is no consistent reporting of state revenue estimates. States make forecasts when it suits them and report them in a manner that is satisfactory to their governors or legislatures. Collection of data through national organizations such as the National Association of State Budget Officers is not so rigorous as to assure that reported data are comparable. In contrast, Medicaid agencies must report their expenditure estimates to the federal government using the federally specified HCFA-37 form once a quarter beginning roughly 30 months before the end of each federal fiscal year.[2]

Second, determining the accuracy of state revenue forecasts relies on the validity of state reported differences between planned and actual expenditure. States may be politically motivated to report these data in a favorable manner. By contrast, Medicaid forecasts, can be compared with accounting data as reported on a federal report known as the HCFA-64. While these data may not be bias free,[3] biases are likely to be small and similar from state to state.

MEDICAID FORECASTING BACKGROUND

Medicaid is a federal and state funded health care financing program. The federal government contributes 50% to 83% of the cost of the program in each state, with states contributing the balance. Medicaid is the largest human services program in state budgets, accounting for 19.2% of total state spending in 1995. It is second only to education in share of state general funds, and has the largest share of federal transfer payments to states (National Association of State Budget Officers, 1996). Medicaid is an entitlement program: once states establish rules about who is enrolled and what is covered they are barred from refusing to enroll eligible individuals or from refusing to pay for covered services due to funding shortfalls. Medicaid pays for health care through vendor payments to health care suppliers (called "providers" by some states). Beneficiaries present their Medicaid cards to enrolled suppliers who deliver services and submit claims to state Medicaid agencies. The state Medicaid agencies pay for these services based on "provider agreements," which set payment conditions. As a result, the Medicaid agency is usually the last to find out about the service. For these reasons, Medicaid budgeting is highly dependent on forecasting.

Because the Medicaid program is funded with both state and federal funds, there are two levels of government who use Medicaid forecasts for budgeting. Practices at these levels of government can be somewhat different. In a typical state government, a Medicaid administering agency makes a forecast that is submitted to an executive budget office for review. Sometimes the executive budget office makes its own independent forecast which may be combined with, or substituted for, the Medicaid agency's forecast (JLARC, 1997). This forecast is then submitted to the state legislature in the legislative budget process. The legislature may make another forecast or may choose to rely on the executive forecast. There can be various mixed practices, for example, a legislative agency may participate in selecting the executive forecast.

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[1] This research is supported by PSC CUNY grant number 666546.

[2] The number of quarters from first reporting a fiscal year to the end of that year has varied from time to time.

[3] States may not anticipate retrospective adjustments in the HCFA-37 although they appear in HCFA-64. Another disadvantage of comparing state forecasting practice using HCFA-37 data is that states may be more interested in their own budgets than in the reporting of their expectations to the federal government. So, the HCFA-37 may not capture the state's best forecast.

The federal government uses the state forecasts in a different way. The states submit their estimates to the Health Care Financing Administration (HCFA), the federal agency responsible for administering the Medicaid grants to states, each quarter using a federal form, the HCFA-37 (formerly the HCFA-25). Forecasts reported on this form are combined to produce national estimates. The federal government adjusts these estimates: (a) to account for new federal policy making that the states could not have known about when making their estimates; and (b) to correct for perceived patterns of errors occurring in past forecasts (Trapnell, 1991). The federal government uses these corrected forecasts to estimate federal Medicaid outlays for the next future federal budget year. Estimates for years beyond those reported in the HCFA-37 are made by the HCFA Office of Actuary using algorithms developed by a contractor prior to 1980 (Trapnell, 1991). In the federal budgeting practice, HCFA budget estimates originating either from the states or the Office of Actuary are subject to scrutiny by OMB and CBO.

In the late 1980s and early 1990s Medicaid agencies experienced several years of significant forecast error. In 1991 HCFA was criticized for unprecedented overages in the Medicaid budget (HHS NEWS, 1991; Executive Office of the President and Department of Health & Human Services, 1991). At that time, the federal government concluded that state forecasting was a significant source of forecasting error (HHS NEWS, 1991). Medicaid and related health care forecasting and cost estimation have been the center of continued disagreement and concern throughout the 1990s (Rich, 1991; Firshein, 1993; Doran, Roesenblatt, and Yamamoto, 1994; Office of Technology Assessment, 1994; Holahan and Liska, December, 1996; Ratner, 1997; Scanlon, 1997; Holahan and Liska, 1997).

EMPIRICAL STUDIES OF MEDICAID PRACTICE

"Forecasting Techniques and Budgetary Issues of State Medicaid Programs" (McKusick, 1980) examines the forecasting practices of 10 state Medicaid programs. Data are gathered from site visits. McKusick observes, "Although each state's estimating techniques are unique, there are patterns that are common to most methodologies." These common patterns include:

- States attempt to estimate demand for service, and pay little attention to supply of service.
- Most state forecasts are prepared on a cash budgeting basis although some forecast accruals and convert to a cash basis.
- In many circumstances, reimbursement rate increase decisions are known prior to budgeting and can be used as an aid to expenditure forecasting.
- Many states have poor quality data sources, but they compensate through inventive use of forecasting techniques.
- Forecasting is understaffed in many states, leaving "many critical forecast issues . . . unanalyzed."
- Few states relate economic conditions to enrollment. Where they do, such analyses may be primarily produced for other governmental functions.
- State Medicaid budget estimates are "determined by the political process," with frequent reliance on supplemental appropriations.
- States forecast no more than a two years horizon.
- States rely on trend analysis, rather than "looking for the underlying driving forces in medical costs."
- Some state forecasts submitted to the HCFA are consistent with their state budget estimates, while others are "the best guess of the analyst."

McKusick describes specific practices in each of 10 states (California, Illinois, Maryland, Massachusetts, Michigan, Pennsylvania, Rhode Island, Texas, Virginia and Wisconsin). Details are not summarized here. The matters he addresses include: the participants in forecasting, the general forecasting approach (e.g., California divides the forecast into current services and policy modifications), number of periodic observations available to the forecast model, level of data (annual, monthly, etc.), sources of data, forecasting techniques used, degree of data decomposition, frequency of forecasting, the state budget calendar, ability to produce data reports for the federal government, relative size of the Medicaid program (to other Medicaid programs nationwide), breadth of Medicaid coverage, and components of Medicaid coverage. Some of the techniques observed include: use of regression or systems of regression models, analysis of "historical trends," use of a weighted average of inflation factor, use of judgment, use of graphing techniques, use of nursing home bed supply information, and use of negotiated rates (Texas).

Because of the interaction with the political process, McKusick expects that states are motivated to underestimate expenditures; however, he observes, "[We] are puzzled that the aggregate of all state estimates should have proven accurate in the past since many have incentives to estimate low and none appear to have incentives to estimate high."

McKusick does not attempt to establish a relationship between these observations and relative forecasting accuracy.

"Better Management for Better Medicaid Estimates," (Executive Office of the President, 1991) reports that from 1980 to 1990 the overall average error of state estimates is -0.3%; however, the federal government is concerned because of error and expected error for 1990 through 1992 as shown in Table 1.

Table 1

Year	Error	Comment
1990	-9.2%	Actual
1991	-18.0%	Expected
1992	-16.0%	Expected

HCFA determined that in 1990, 19 states had errors greater than 10% and 4 (Alabama, Kansas, Arizona and Massachusetts) had errors greater than 20%. Error rates for the largest states grew from below 5% in 1990 to an unweighted average of 17% in 1991 as follows: Texas – 27%, New York – 17%, and California – 7%, for a gross total of $2.1 billion.

A HCFA/OMB task force visited nine large states that account for approximately 50% of all Medicaid expenditure in 1991 and 1992 (Alabama, California, Florida, Maryland, Massachusetts, New York, Ohio, Pennsylvania, and Texas). They found: "Mis-estimates in these States appear to be due primarily to changes in Federal . . . policies . . . . Only about one-third of the mis-estimates were attributable to problems in the States' estimating processes. Economic trends appear to play a lesser role." Programmatic sources of cost increase include health care inflation, court orders, and use of provider taxes and refundable donations. Specific observations about state processes include:

- Some States have well qualified personnel and employ sophisticated estimating models; others do not.
- States that link Medicaid estimating to their State budget processes appear to produce more accurate estimates than those that do not.
- Many States do not take reporting to the Federal Government . . . seriously, and thus do not provide accurate, complete or timely estimates.
- Many States do not provide the Federal Government with the assumptions used in making estimates. No distinction is made between baseline estimates and program estimates.
- Technical problems include differences in fiscal years and State use of accrued versus cash budgeting. (Executive Office of the President, 1991)

Some of these observations involve communication problems between the state and federal governments. Observations that appear to account for forecasting accuracy include (1) the assertion that forecaster qualification varies, and (2) the observation that states who link state and federal budgeting seem to provide the federal government better forecasts. Evidence is not presented.

Gordon R. Trapnell examined Medicaid forecasting in the early 1990s and produced two reports (Trapnell, 1991; Trapnell, 1994). The 1991 study reports empirical findings. It serves two purposes, one is to explain particular forecast errors occurring in 1991 and 1992 (as anticipated in 1991). The other is to provide some insight into the federal use of state forecasts. While this discussion reveals some familiarity with particular practices of some states, it does not show comparison of actual practices and their forecasting casting consequences among the states. Trapnell's data collection method is not revealed, it appears that he relies primarily on information already in the hands of HCFA. His observations regarding state practices are as follows:[4]

- Variation in forecasting accuracy may relate to composition of Medicaid beneficiary enrollment.
- State legislators may choose to implement new polices that are underestimated, that is, where political pressure for policies is high in relation to

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[4] Trapnell attributes some of these observations to McKusick's study.

the determined costs.

- States may defer spending at the end of a state fiscal year to ensure that state fiscal year estimates are correct. This can happen because many states budget on a cash basis rather than an accrual basis.
- Data available for forecasting in some states may be of poor quality or may not be reconciled with actual expenditure experience.
- Past federal action may discourage states from revealing their true estimates. In particular, in 1982 the federal government penalized states whose actual expenditures exceeded their forecasts. As a consequence, states may be motivated to overstate their estimates.
- There is wide variety in the sophistication of state forecasting from "trended forward total aggregate spending by type of service" to "fully specified econometric model . . . . refitted quarterly."
- Only a few states fully disaggregate data by the type of service and type of beneficiary.
- Locus of responsibility varies among the states, with Medicaid agencies preparing some forecasts, while budget officials preparing others.
- There is "some correlation between how well officials understood the programs and the details incorporated in the cost estimates."
- State forecasts improve as the horizon between forecast and the end of the fiscal year diminish.
- States may not reconcile state and federal fiscal year reporting (most state fiscal years are from July to June, while the federal fiscal year is from October to September).

Trapnell's analysis of state variation is limited to two paragraphs of his report in which he compares regional aggregate variation between the HCFA-37 and HCFA-64 reports. He finds that states in Region 1 (states in each region are shown in Table 2) consistently underestimates its expenditures, states in Region 2 generally overestimate expenditures and states in Region 9 are usually very accurate. Trapnell's report makes no effort to account for these variations in accuracy. However, the most obvious characteristic of regions Trapnell mentions as having consistent patterns of accuracy are that they are dominated by a single state. New York accounts for about 85% of federal expenditures in Region 2 and California accounts for a similar amount in Region 9. In Region 1, Massachusetts[5] accounts for about 60% of federal expenditures. It is likely that the explanation for the various forecasting results in these three regions will be found at these three states.

Table 2

Region 1	**Region 2**
Connecticut	New Jersey
Maine	New York
Massachusetts	Puerto Rico
New Hampshire	Virgin Islands
Rhode Island	
Vermont	
Region 3	**Region 4**
D.C.	Alabama
Delaware	Florida
Maryland	Georgia
Pennsylvania	Kentucky
Virginia	Mississippi
West Virginia	North Carolina
	South Carolina
	Tennessee
Region 5	**Region 6**
Illinois	Arkansas
Indiana	Louisiana
Michigan	New Mexico
Minnesota	Oklahoma
Ohio	Texas
Wisconsin	
Region 7	**Region 8**
Iowa	Colorado
Kansas	Montana
Missouri	North Dakota
Nebraska	South Dakota
	Utah
	Wyoming
Region 9	**Region 10**
American Samoa	Alaska
Arizona	Idaho
California	Oregon
Guam	Washington
Hawaii	
Northern Mariana	
Nevada	

Michele Insco of the Colorado state government conducted a Medicaid budget survey and circulated results to participating states in May, 1992 (Insco, 1992). This study consists of charts demonstrating factors that might affect forecast accuracy or expenditure values. Some variables charted include: state population, percent change in Medicaid expenditure from FY 91 to FY 92, characteristics of the Medicaid program including various policy factors of current interest in 1992, basis of accounting, and beginning/ending dates of state fiscal year. Some of the characteristics reported include the percent of poverty at which pregnant women and certain children meet eligibility criteria, experience with Boren Amendment lawsuits,[6] percentage of births in the state covered by Medicaid, coverage of certain optional populations, etc. There is no accompanying written report to interpret these charts. By implication, these variables are thought to bear a relationship to expenditures and forecast accuracy.

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[5] Massachusetts has two Medicaid agencies, the smaller of which is about 2% of the program. This analysis excludes the smaller agency.

The Human Services Finance Officers sponsored a survey of Medicaid budget estimation methods by Deborah J. Lower (1993). Lower reports that her survey is an extension of the Insco survey and is aimed at "determining what techniques were being used in other states to assist them in responding to legislative and executive branch questions." Lower surveyed the 50 US States and D.C., and reports a response rate of 84% (43 states). Lower's study focuses on identifying practices rather than determining sources of variation. Lower does not attempt to evaluate the relationship between these practices and forecast success. Practices she finds are as follows.

General:

- States use their own forecasts as compared with contracting out forecasting functions.
- Staff time required to complete the HCFA-37 ranged from 0.1 to 15 FTE and averaged at 1.6 FTE. (The phrasing of this question appears to limit the this response to completion of the form, and may exclude time required for forecasting.)
- The HCFA-37 may be completed in differing categories than state budget forecasts.
- Technical background of staff completing the HCFA-37 or related forecasts includes actuarial science, accounting, budget, statistics, program/policy analysis, economics, management analysis and demographics.
- Budget office staff ranged from 1 to 44 employees and averaged at 7.8 FTE.
- Primary responsibility for the Medicaid budget is with budget or finance agencies in 17 states and program or departmental administrators or staff 25 states.
- Twenty-six states report formal relationships between budget and finance staff and program staff.
- Program staff have access to expenditure data in 35 states.
- Some states report that program staff do not have adequate technical skills for forecasting.
- States report that Medicaid accounts for 4% to 52% of state budgets, averaging at 15.96%.
- Forty states report the existence of written gubernatorial guidance in budget preparation.

Caseload Projections:

- Thirty-seven states use data concerning eligibility (enrolled beneficiaries).
- Thirty-one states evaluate population categories.
- Twenty-seven states evaluate federal mandates for impact on enrollment.
- Twenty-three states use "program specific information."
- Five states evaluate the impact of "retroactive eligibility."[7]
- Twenty-eight states report that they forecast based on cash data (expenditures on date of claims payment).
- Eight states report that they forecast based on accrual (service date) data.
- Four states report use of both cash and accrual data.
- Six states report lack of access to "extract data."
- Lag time between service date and payment date is variable between states and between service categories.
- The predominant periodicity of data is monthly.
- The average length of a forecasted data series is 5 years.

Utilization

- Nineteen states report estimating utilization directly from enrolled beneficiaries.
- Twelve states report using an intermediate

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[6] The Boren Amendment is language in Title XIX of the Social Security Act that allows states to pay institutional health care providers for efficient delivery of health care. It is widely held that the amendment was originally passed to allow states to avoid paying excessive amounts to hospitals and nursing homes. However, courts have interpreted it to prohibit states from paying hospitals and nursing homes too little. The Boren Amendment was repealed in 1997.

[7] Retroactive eligibility is the awarding of eligibility for a period that is in the past.

determination of service recipients.

- Eleven states report use of both techniques.
- Eighteen states use seasonal adjustments for some services.

Price Level

- States uses price indexes such as CPI or local indexes.
- States evaluate the impact of lawsuits.
- Historical patterns may not be evaluated.
- Thirty-seven states evaluate price level change by service type.
- Twenty-one states evaluate price level change by eligibility category.
- Eight states evaluate price level change by other demographic categories.

Frequency of forecasts:

- Sixteen states report updating forecasts quarterly.
- Ten states report updating forecasts "as needed."

Software Usage includes:

- Spreadsheets (Lotus, Excel, Quattro Pro)
- Statistical software (SAS, SPSS)
- Forecast software (Forecast Pro)
- Mainframe forecasting programs (five states)

Program features:

- Fifteen states report no HMO enrollment.
- Other states report enrollment from 553 to 384,377 (Lower does not provide bases for percentage calculations).
- Twenty-two states report involvement in Boren Amendment lawsuits.
- Of thirty-two states reporting data, the percentage of births reimbursed through Medicaid ranged from 14% to 56% and averaged at 36.4%.

Data sources used by states to estimate impacts of new policies include:

- Program information (41 states)
- Information from other states (40 states)
- Census data (36 states)
- Insurance company consultation (14 states)
- Providers, actuaries, health or research data, and historical patterns.

Difficulties states report include:

- Last minute program and policy changes.
- Accuracy of population growth estimates
- Accuracy of utilization estimates.
- Budgetary constraints (state restrictions vs. federal mandates).
- Data validity.
- Technological advancements.
- Variation in lag between service date and payment date.
- Retroactive adjustments.

It is difficult to compare these empirical studies because of the small number of agencies studied and differences in specific matters observed. Yet, some topics persist. McKusick, Executive Office of the President (EOP), Insco, and Lower look into whether forecasts concern cash expenditures or intermediate accruals, and each finds variation in state practices. McKusick, EOP, and Lower find variation in staff capacities. McKusick and Trapnell find a relation between Medicaid forecasting and the political environment. McKusick, Trapnell, and Lower find variation in techniques used, degree of data disaggregation, data quality, and locus of forecasting responsibility. Also, they find that many states attempt to account for policy making that affects Medicaid expenditures. McKusick and EOP find that some states treat federal forecast reporting differently than state purpose forecasting.

On most commonly discussed matters, findings are consistent across the various studies. It is not possible to determine change over time. For example, McKusick's data are too vague and his sample too small for comparison with Lower.

NORMATIVE APPROACHES TO MEDICAID FORECASTING

Three HCFA guidelines for forecasting are examined: (1) Charts from a presentation on forecasting, (2) normative guidelines in "Better Management for Better Medicaid Estimates" (1991), and (3) HCFA-37 reporting expectations.

HCFA (1990)[8] recommends structuring the Medicaid forecast using of the formula:

$$E(y+1) = P \times U \times C$$

or

$$E(y+1) = E(y) \times (1 + \Delta P) \times (1 + \Delta U) \times (1 + \Delta C)$$

where, E(y+1) is the future year expenditure, P is the projected price, U is the projected utilization,[9] C is the projected enrollment of beneficiaries,[10] E(y) is the current year expenditure, and Δ denotes year to year change calculated as ((Year 2)- (Year 1))/(Year 1). These formulae are sometimes called the PUC model (Price, Utilization, and Caseload),[11] Sometimes the first version is called the direct method and the second is called the incremental method. They provide a structure for calculating expenditures within each expenditure category. Although HCFA suggests that the direct method is more accurate, some of their material seems to recommend the use of the indirect method; perhaps because it is thought that the it is less difficult to find data supporting the indirect method. HCFA also recommends adjusting forecasts to reflect cash flow factors (lag between service date and payment date), decomposition of data into groups of homogeneous sub-populations, calculation of marginal-to-core ratios,[12] and the use of demographic data to help identify marginal and core groups.

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[8] These guidelines are demonstrated in charts and tables, with limited narrative discussion.

[9] With Medicaid, utilization can have several meanings. HCFA offers two definitions: Service unit per enrolled beneficiary and claims frequency. HCFA recommends the earlier definition. This utilization is a combination of two factors: ratio of beneficiaries using services (sometimes called "recipients") to beneficiaries enrolled and ratio of

Normative guidelines in "Better Management for Better Medicaid Estimates" (1991) are primarily directed at HCFA. State oriented recommendations include: requiring states to provide baseline (no policy change) estimates, listing of assumptions underlying these baseline estimates, and requiring separate estimate of expected changes. It is not clear whether the framers of these guidelines intend that states will make better forecasts using these guidelines, or merely that HCFA will have a better change to discovering poor forecasts.

The HCFA-37 does not explicitly require states to use any particular approach for forecasting. Nevertheless, the form calls for the state to report on various forecast elements in a manner that is consistent with the direct method PUC model along with separate reporting of base line and expected changes. To fulfill HCFA's reporting requirements, the state must either structure its forecast to be consistent with the PUC model or it must compute PUC model variables from its actual forecast. Some states refer to this latter option as "backing into" the HCFA forecast. Over time, the HCFA-37 has also added schedules to capture data on special issues of interest to the federal government. For example, at some times HCFA-37 reporting has included extensive reporting on the use of disproportionate share adjustments to hospitals.[13] Sometimes these schedules involve reporting anticipated effects of recently passed federal legislation. The structure of these schedules may or may not reflect normative views concerning how HCFA thinks states should estimate these policy changes.

Trapnell (1991) discusses a variant of the PUC model that includes the marginal-to-core ratio. This model disaggregates Medicaid into 29 service categories, which are further decomposed into five components:[14]

$$E(y+1) = E(y) \times (1 + P(y+1)) \times (1 + U(y+1)) \times (1 + M \times C(y+1))$$

where, E(y+1) is the future year expenditure, E(y) is the current year expenditure, P(y+1) is the projected change in price, U(y+1) is the projected change in utilization, C(y+1) is the projected change in enrollment of beneficiaries, and M is the marginal-to-core factor. Some of these components may require separate calculation for each enrollment category. Other components are essentially static, or are estimated from sources outside of HCFA.

Trapnell implies that use of this or a similar model would be the best method for states to forecast Medicaid expenditure. However, elsewhere he says that the most important elements of good state forecasting are use of a skilled and attentive staff working within a comprehensive analytic framework. The PUC model serves as the analytic framework.

Trapnell's "Best Practices Guide for Preparation of Medicaid Budget Estimates," (1994) presumably reflects his findings in his 1991 study.[15] Most of Trapnell's advice is general with no special application to Medicaid. For example, he advises agencies to avoid expectations of accuracy that cannot be met and to be sure that outputs address client officials data needs. He

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service units to recipients. Sometimes "utilization" is used to refer to one or the other of these component concepts.

[10] HCFA recommends that caseload be measured in average monthly enrolled beneficiaries per year.

[11] Sometimes, owing to a rearrangement of the variables, this model is called the CUP model.

[12] Marginal to core refers to an expectation that incremental element of enrollment will have a different utilization pattern than the base (core) enrollment. This view can involve several unrelated matters. First, newly enrolled beneficiaries may have a different usage pattern. It may take awhile for them to establish relationships with medical care providers, so their usage may be lower. On the other hand, they may be more urgent to obtain services that have been postponed while they had no health financing resources, so they may use more services. Second, it is likely that there will be a lag between enrollment and payment for services. As the federal government budgets on a cash basis, this lag appears as a reduced cost in the first year of service.

[13] Disproportionate share hospital adjustments have been a source of friction between states and the federal government since the early 1990s.

[14] Notation is slightly changed.

[15] The author has direct knowledge that Trapnell made site visits to other states beyond those discussed in the 1991 study.

recommends evaluating forecasts through production of numerous outputs that can be compared with actuals, comparing forecasts with earlier forecasts of the same series, and making frequent forecast updates. He recommends usual forms of pre-forecasting such as disaggregating data and adjusting for non-recurring events, missing data, and lag time between accrual of liabilities and cash transactions. He recommends optimizing the use of knowledge by such actions as establishing a relationship with program staff; distinguishing between matters that must be forecast and those that can be know; and distinguishing between the near future, about which forecasters may have special knowledge, and the distant future, about which they know considerably less.

Trapnell raises considerable concern over data used in Medicaid forecasting. This concern reflects a lack of faith in Medicaid data and health care data in general. Data concerns include completeness, reliability, validity and timeliness of data. He suggests several methods of verifying data validity, by which he means that the data is what it purports to be. Data can be validated by reconciling with accounting records, by examining the process of its production when produced by the Medicaid agency, and by examining the documentation of its production and meaning when produced by others.

Trapnell recommends the use of an analytic model to assure that the forecast addresses all elements of expenditure. The model he recommends is a anothcr variant of the PUC model.

Trapnell lists nine special features of Medicaid that make forecasting Medicaid expenditures harder than other health care expenditure forecasting these are:

1. Criteria for Medicaid eligibility are very complex.
2. Many beneficiaries are eligible and enrolled only for short periods.
3. Some individuals become eligible for Medicaid in part because they have high medical bills, so they can be expected to continue to have high medical bills.
4. Medicaid policy making leads to frequent changes in payment levels.
5. Documentation of expenditures is incomplete.
6. There are inconsistent definitions of data in accounting and claims processing.
7. There are constant changes in the program resulting from federal and state legislation, new regulations, administrative initiatives, and court decisions.
8. The political process leads to a random patterns of interventions in payment rates and other program features.
9. Medicaid agencies need to be able to explain their forecasts to officials and interest groups.

Consequently, he recommends that the Medicaid forecast should:

1. Be easy to understand and test for reasonableness.
2. Be easy to adjust for changes.
3. Be easy to incorporate ad hoc adjustments.
4. Be easy and inexpensive to re-estimate using newer data.
5. Be easy to change to accommodate program changes.
6. Produce numerous outputs to compare with actual experience.
7. Produce outputs that fulfill forecast users' needs.

Trapnell also recommends that:

- Medicaid forecasting methodology should be able to detect frequent unexpected shocks to the expenditure system;
- Forecasting should be insulated from political interference;
- Staff should be assigned to forecasting as their full main work function, and
- The loss function that forecasters should minimize is the consequences of forecast error. Trapnell assumes that there equally negative consequences for positive and negative errors, thus, he recommends a symmetrical loss function.

Trapnell does not recommend any specific forecasting technique. He recommends against the use of complex econometric models or "black box" techniques, excessive reliance on high technology, or reliance on any single technology. Positive recommendations include use of simple techniques, fitting techniques to the data and the nature of the problem, and allocating resources for forecasting based on criteria of importance and difficulty.

The National Association of State Budget Officers (NASBO) issued a brief guideline on Medicaid estimation practices (National Association of State Budget Officers, 1991). NASBO offers the general model:

> "Simply put, a state's expenditure on Medicaid is the product of the number of people using its services (caseload) and the cost of providing those services (price). Several variables must be accurately forecast for the overall estimate to be correct: the economic environment in which the Medicaid program operates, the eligible popula-

tion, the types and prices of services used, the participation rate among eligible participants, policy initiatives, and the federal match rate.

This guideline lists nine recommended practices:

1. Include the budget agency, the Medicaid agency, and the legislative fiscal agency in the development of a Medicaid spending estimate. This is labeled a "general practice" which serves consensus building.
2. Ensure that the economics of the spending estimate are consistent with those of the revenue estimate. This practice is of greater concern at turning points when revenue and spending assumptions may become disconnected.
3. Ensure that the population assumptions used in the Medicaid estimate are consistent with overall state demographic trends. Various state agencies should communicate to assure that estimates of related coverage groups are adequately coordinated.
4. Maintain good data. Recommended data elements include users, their attributes, and the services they use.
5. Establish the price of services before the fiscal year begins. The aim is to remove uncertainty. "In general, states will find it easier to develop accurate spending estimates if the cost of services is set before the fiscal year begins. States that reimburse for actual costs incurred are at a disadvantage in this respect."
6. Account for caseload changes associated with outreach efforts. This concern involves the interaction between various programs and the possibility that outreach for one program will affect another program.
7. Track federal and state legislation and regulations. This practice concerns the frequent changes in policies that affect Medicaid spending.
8. Know the federal match rate[16] and the likelihood of it changing. This concern involves the distribution of costs between federal and state governments. Forecasting, in this sense, is oriented towards the costs to the state.
9. Monitor the estimate. Even good estimates can be wrong. Medicaid agencies should produce monthly or quarterly reports that compares Medicaid spending with the original estimates. Deviations should be explained, so that forecasting can improve over time.

Recommendations 2 and 3 may improve accuracy if the facilitate communication between forecasters who have different perspectives on the state economy. Recommendation number 4 is similar to one of Trapnell's chief concerns, but Trapnell provides more explicit advice concerning its implementation. Where states are able to comply with recommendation number 5, they eliminate the need to forecast what they can know. Recommendation number 6 appears to be idiosyncratic to particular concerns of the early 1990s; however, it also seems to reflect Trapnell's more general principle to maximize the use of knowledge. HCFA, Trapnell and NASBO all show considerable concern over the impacts of policy making as discussed in recommendation 7. Recommendation number 8 involves monitoring, not forecasting. It also reflects Trapnell's principle to maximize use of knowledge.

The Congressional Budget Office uses of a model similar to HCFA's (Muse, 1993). Muse's concern is not to describe the forecasting of the ongoing program, but the method of estimating costs of program changes. The particular changes he is concerned about involve preventive child health. He recommends the use of the following model:[17]

$$\Delta T = \Delta C \text{ x } \Delta P \text{ x } \Delta U + \Delta A - O$$

where, Δ means "change in," T is total payments, C is population, P is price, U is utilization, A is administrative costs or savings, and O is offsets. Muse's notation is confusing. If one assumes that ΔC, ΔP, and ΔU are ratios[18] as discussed by HCFA or Trapnell, then this formula needs the modification of including the base reimbursement in the right hand and the deletion of the change symbol on the left hand side of the formula; let B_1 = the base expenditure level for medical care and B_2 = the base expenditure level for administration:

$$T = B_1 \text{ x } (1+\Delta C) \text{ x } (1+\Delta P) \text{ x } (1+\Delta U) + B_2 + \Delta A - O$$

or

$$\Delta T = B_1 \text{ x } \Delta C \text{ x } \Delta P \text{ x } \Delta U + \Delta A - (O + B_1)$$

If one assumes that ΔC, ΔP, and ΔU are numbers in their original dimensions, rather than ratios, then a much more complex formula would be required:

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[16] "Match rate," is one of several terms used to refer to the proportion of Medicaid costs paid by the federal government. Other terms are FMAP rate, FFP, federal share, match, etc. This rate is published in the *Federal Register* in January or February each year with an effective data of the following October 1. Federal Funding Information for States (FFIS), an offshoot of the NASBO, monitors matching rates and forecasts changes prior to their official publication in the *Federal Register*.

[17] Notation is modified.

[18] ΔA would still be a fully dimensional number.

$$\Delta T = \Delta C \times P \times U + \Delta P \times C \times U + \Delta U \times C \times P + \Delta C \times \Delta P \times \Delta U + \Delta A - O$$

where, C, P, and U are the population, price, and utilization levels *after* the policy change and ΔC, ΔP, and ΔU are the changes that led to these new levels. Muse's multiplication of changes by changes omits the effect of changes on the base program, which is likely to be the main effect of policy changes except in the rare circumstance that new beneficiaries getting new services and no old beneficiaries or old services are involved.

Muse's formulation adds two important considerations, impact on administration and offsets. These concerns are more pertinent with program changes where administration may not already be provided for and offsets may have a direct budgetary effect. Presumably, when forecasting the ongoing program, administration is already included in the budget and can be estimated directly. This principle is reflected in the HCFA-37 form, which has a separate section for administrative expenses. Offsets resulting from the base program are reflected in the base and do not require separate estimation.

Muse also provides considerable discussion of data quality. This discussion focuses on three data sources, the Current Population Survey, the "Statistical Report of Medical Care: Eligibles, Recipients, Payments, and Services," (also known as the HCFA-2082 report), and the Medicaid Statistical Information System (MSIS). Muse discusses the uses and weaknesses of these data sources. This discussion is not specifically normative; however, it exhibits the same sort of concern raised by Trapnell and NASBO, the forecaster/estimator must attend to data quality.

Of special concern for estimators of new policy impacts is an estimate of participation level for newly eligible individuals. For the base program, participation level is not a significant issue except where forces, such as outreach, might be changing this level. For newly eligible individuals, the estimator needs to anticipate the degree to which this new population will seek to obtain services. Muse says that this question is not easily resolved.

Muse raises several objections to including estimates of offsets in projecting new program costs. Two major reasons for this objection are (1) uncertainty – evidence may be weak, elements of cost may be omitted from calculation of offsets, etc.; and (2) lack of impact – the beneficiary of the offset may be someone other than the entity who must make the cash outlay to obtain the offset. In estimating and forecasting for budgets, one must remain aware of the cash outlay consequences of forecasted events.

Muse also observes that estimators should engage in reality checking; that is, comparing calculated results with the views that people might expect in the real world.

The Joint Legislative Audit and Review Commission of the Virginia General Assembly (JLARC) has reviewed Virginia's Medicaid forecasting in 1992 and 1997.[19] In reports of these studies, JLARC recommends six criteria for forecast models and five criteria for a forecasting process (1991; 1997). These criteria are shown in Tables 3 and 4.

Table 3: Criteria for Forecast Models
1. Model assumptions are clearly understood by participant and periodically reviewed.
2. Variables used in models' equations are sufficient, accurately measured, and the best information available at the time.
3. Equations are mathematically sound and tested to ensure mathematical precision
4. Different regional conditions are taken into account sufficiently.
5. Forecast errors are analyzed on an ongoing basis.
6. Forecast models are reviewed and documented well, including any judgmental or policy adjustments

Table 4: Criteria for Evaluating Forecasting Process
1. The degree of uncertainty associated with forecasts should be understood by process participants.
2. The agency making forecasts should have the data and personnel required to generate a good estimate.
3. Regular reports on actual expenditures and their variance from forecasts should be developed and available to agency staff and interested external participants, as appropriate.
4. The process should maintain the flexibility to respond to dramatic changes in recipient utilization and program expenditures by revising the forecasts.
5. The process should include a mechanism requiring some level of expanded review of the forecasts. (Expanded review means review by people not involved in initial forecasting, such as an external panel

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[19] (1) The author was the budget director at the agency that administers Medicaid in Virginia in 1991. (2) Other states have conducted similar studies; however, there is no systematic method for finding such reports.

Excepting criterion 4 in Table 4, these criteria might be applied to any forecasting problem. Most appear to be a subset of more extensive criteria used in evaluating revenue forecasting (Joint Legislative Audit and Review Commission, 1991).

Many of these normative guidelines support the goal of forecasting accuracy. For example, JLARC recommends that formulae be valid and NASBO, among many others, recommends the use of good data. Yet, many other recommendations concern other matters. For example, Trapnell recommends against unrealistic expectations of forecast results; similarly JLARC recommends that forecast participants should understand the degree of forecast uncertainty.

RELATION TO REVENUE FORECASTING

Revenue forecasting literature suggests a tendency for an asymmetrical forecasting loss function, favoring a cushion between total revenue and total expenditures (Rodgers and Joyce, 1996). The rationale is that the penalty for overestimated revenue is greater than the penalty for underestimated revenue. Similar reasoning would have states overestimate expenditures in major expenditure categories such as Medicaid. Surpluses are less damaging and, in many states, can be reprogrammed at the end of the fiscal year to offset deficits elsewhere.

However, cushioning budgets through overestimation of Medicaid expenditures differs from underestimation of revenue in one important respect. It changes the locus of control over the cushion. Unappropriated revenue – which is the status of unexpected revenue resulting from greater receipts than budgeted – is, generally, controlled by the central administrative agencies or the legislature. Over-appropriated funds, resultant from appropriating funds to Medicaid agencies based on overestimated forecasts, are controlled by line agencies. As there is a natural distrust between central administrative agencies and line agencies, it is unlikely that states would intentionally allow line agencies to control surplus funds.

Nevertheless, the line agencies, who submit the HCFA-37, may be motivated to seek surplus funding as a cushion against their own forecast error. There would be no advantage for these line agencies to make separate lower estimates for HCFA.

Trapnell argues that agencies might find differing but equally negative consequences for overestimating and underestimating expenditures. McKusick proposes that there is lower penalty for underestimation. On the other hand, Muse's rationale for not counting offsets in estimating program changes suggests a higher penalty for underestimation.

The conflict concerning presence and direction of bias can be explained by several factors. First, McKusick's study reported in 1980 reflects a relatively small Medicaid program. With this small program, political decision making may be more important than financial risk, as is also suggested in some of Trapnell's discussion. In their effort to maximize their distribution of benefits, elective officials may consider a small risk of over expenditure to be less important than their ability to distribute benefits to more people. Still, neither McKusick or Trapnell found empirical evidence of actual underestimation.

SOME HYPOTHESES

These studies provide little explanation of relative forecasting accuracy. However, they are a source for many hypotheses about Medicaid forecasting. In general these hypotheses are found by extrapolating the objective of normative guidelines or the reasons for inquiry in empirical studies. To a large degree, where there is explanatory discussion, most of the views agree with each other. In a few cases, as with the matter of asymmetrical loss function, there is disagreement. Where there is disagreement, the cited sources may not all support the form of the hypothesis expressed here. Following are hypotheses that can be extracted from this body of literature:

1. States' loss functions will be asymmetrical with a preference for overestimation (Trapnell, McKusick, Muse). McKusick proposes a preference for underestimation. Trapnell offers conflicting views, (1) he argues that the political environment equally punishes over- and underestimation, (2) he points out that past federal behavior may create a bias for overestimation, and (3) he proposes that underestimation bias arises from frequent selection of policy initiatives that are underestimated.
2. States manipulate fiscal year end results to improve forecasting results within state budgeting. By implication states whose fiscal year ends coincide with federal fiscal year ends will appear to be more accurate (EOP, Trapnell, Insco).
3. Forecast models result in more accurate forecasts when they:
   a) Account for delivery of medical care on service date with lagged transformation to cash payment date (McKusick, Insco, Lower, Trap-

nell, Muse).

- b) Decompose data into homogenous service and enrollment categories (McKusick, Trapnell, Lower).
- c) Reflect the PUC model or an extended version of the PUC model (HCFA, Trapnell, Muse, NASBO).
- d) Relate enrollment to economic conditions (McKusick).
- e) Relate service utilization with service supply (McKusick).
- f) Decompose series into baseline and policy events (McKusick, Trapnell, Lower, EOP, HCFA, NASBO, Muse, JLARC).
- g) Decompose utilization into recipients per beneficiary and units of service per recipient (Lower).
- h) Relate price estimates to price indexes (Lower, Trapnell).
- i) Account for federal matching rates (NASBO).
- j) Account for regional variation (JLARC).

4. Forecasting accuracy is affected by:
   - a) Staff
     - i) Skill (EOP, Lower, JLARC).
     - ii) Quantity (McKusick, Lower, JLARC).
     - iii) Dedication to the forecasting function, as opposed to part-time forecasting (Trapnell).
   - b) Forecaster understanding of:
     - i) Forecast model assumptions (JLARC).
     - ii) The Medicaid program (Trapnell).
   - c) Forecaster access to program staff (Trapnell).
   - d) Data:
     - i) Quality (McKusick, Trapnell, Lower, NASBO, Muse, JLARC).
     - ii) Sources (Lower, Trapnell, Muse).
     - iii) Periodicity (monthly, etc.) (McKusick, Lower).
     - iv) Series length (Lower).
   - e) Setting rates prior to forecasting (McKusick, Trapnell, NASBO).
   - f) Composition of the Medicaid program (McKusick, Trapnell, Insco, Lower).
   - g) Update frequency (Trapnell, Lower).
   - h) Length of forecast horizon (Trapnell).
   - i) Decomposition of forecast into near future and distant future (Trapnell).
   - j) Whether seasonality is examined (Lower).
   - k) Use of software:
     - i) Spreadsheets (Lower).
     - ii) Statistical software (Lower).
     - iii) Forecast software (Lower).
   - l) Use of pre-forecast data editing (Trapnell).
   - m) Insulation of forecasting from politics (Trapnell).
   - n) Allocation of forecasting resources to problems (components) according to difficulty and importance (Trapnell).
   - o) Use and quality of forecast evaluation (Trapnell, NASBO, JLARC).
5. Intra-governmental forecasting factors that affect forecasting accuracy include:
   - a) Locus of primary forecasting responsibility – Medicaid agency or other state agency (McKusick, Lower).
   - b) Cooperation between forecasting bodies (Lower, NASBO, JLARC).
   - c) Whether there is coordination between Medicaid forecasting and other state forecasting (NASBO).
   - d) Use of "expanded review" (JLARC).
6. Accuracy is improved when forecasting techniques are:
   - a) Simple (Trapnell).
   - b) Not "black box" (Trapnell).
   - c) Fit to the nature of the problem (Trapnell).
   - d) Fit to the quality of the data (Trapnell).
   - e) Easy to use (Trapnell).
   - f) Capable of detecting the effects of policy shocks (Trapnell)
7. Forecasting accuracy is not associated with the use of any particular forecasting techniques (Trapnell). However, McKusick suggests the opposite, implying that more sophisticated techniques may result in greater accuracy.
8. When multi-stage forecasts are used, accuracy of later stage forecasts depend on the accuracy of earlier stage forecasts (Trapnell).
9. Large policy events affect forecasting accuracy. In particular, forecasting accuracy is affected by:
   - a) Boren Amendment Lawsuits (Insco, Lower).
   - b) Federal policies concerning pregnant women and children (Insco, Lower).
   - c) State initiatives involving Disproportionate Share Hospitals (Trapnell, EOP).
10. Perceived forecasting importance affects accuracy and bias. In particular:
    - a) The relative size of the Medicaid program to other state programs affects accuracy. As the program increases in relative size, accuracy becomes more valued (McKusick, Lower). McKusick does not offer this view, instead it

is implied in his observation of low concern for accuracy in 1980, when Medicaid programs were comparatively small components of state budgets.

b) The centrality of forecast preparation to state budgeting (McKusick, EOP). EOP observed that states who prepare their federal budget forecast in connection with their state budget forecast appear to submit more accurate federal forecasts. However, it is the current author's observation that this relationship may be complex. If state budget forecasting is biased for political reasons, independent forecasts may be more accurate.

c) The relative share of expenditures paid by state funds, as compared with federal funds, affects forecast accuracy (NASBO). Where states pay a higher share – that is, have a lower match rate – they will be seek greater forecasting accuracy.

Table 5

	States		Federal	
Year	UnwAvg	CumAvg	UnwAvg	CumAvg
1982	-4.7%	-4.7%	21.6%	21.6%
1983	-5.3%	-5.0%	12.8%	17.2%
1984	-4.9%	-5.0%	54.7%	29.7%
1985	-3.6%	-4.6%	53.7%	35.7%
1986	-0.3%	-3.7%	-0.4%	28.5%
1987	8.1%	-1.8%	-0.2%	23.7%
1988	8.9%	-0.2%	9.5%	21.7%
1989	6.6%	0.6%	13.1%	20.6%
1990	8.4%	1.5%	-2.8%	18.0%
1991	23.8%	3.7%	43.9%	20.6%
1992	35.5%	6.6%	43.2%	22.6%
1993	6.8%	6.6%	46.0%	24.6%
1994	-6.2%	5.6%	78.1%	28.7%
1995	-1.5%	5.1%	7.9%	27.2%

UnwAvg. = Unweighted average.
CumAvg. = Cumulative average.
Percent error 24 months prior to fiscal year end.

EVALUATION OF HYPOTHESES

These hypotheses are too numerous to fully evaluate in this paper. Further, for many operationalization may be problematic. The following discussion discusses evidence concerning some of these hypotheses:

Hypothesis 1: States will exhibit an asymmetrical loss function with a preference for overestimation.

Analysis of this hypothesis is based on data from the HCFA-37/HCFA-25 budget requests and the HCFA-64 accounting records for the years 1982 through 1995. Over this period, the longest horizon consistently available is 24 months before the end (12 months before the beginning) of the fiscal year. Data are divided into two groups, one for the 50 states,[20] and another for the 6 federal districts and territories. Errors are analyzed using the percent error [(Actual minus Forecast) divided by Actual]. As the forecast is subtracted from the actual, a negative error means the forecast exceeded actual expenditures.

As shown in Table 5, states have negative valued errors in 7 of 14 years, and positive valued errors in the remaining 7. Cumulatively, the error is negative for the first 7 reported years, and positive for the remaining 7 years. Table 6 shows that more than 50% of states have negative errors in 6 years, while they have positive errors in the 8; however, cumulative errors are negative in 8 of 14 years.

Table 6

	States		Federal	
Year	% <=0	Cum. %	% <=0	Cum. %
1982	71.4%	71.4%	40.0%	40.0%
1983	79.6%	75.5%	0.0%	20.0%
1984	74.0%	75.0%	20.0%	20.0%
1985	78.0%	75.8%	16.7%	19.0%
1986	46.0%	69.8%	83.3%	33.3%
1987	20.0%	61.4%	66.7%	39.4%
1988	22.0%	55.7%	16.7%	35.9%
1989	22.0%	51.5%	33.3%	35.6%
1990	22.0%	48.2%	66.7%	39.2%
1991	8.0%	44.2%	33.3%	38.6%
1992	4.0%	40.5%	16.7%	36.5%
1993	38.0%	40.3%	50.0%	37.7%
1994	80.0%	43.4%	0.0%	34.7%
1995	62.0%	44.7%	0.0%	32.1%

These results appear to imply that state forecasting of Medicaid expenditures is unbiased. However, this understanding may be incorrect. Medicaid has experienced differing phases of policy activity. During the early 1980s, policy making activity was relatively low. However, in the mid-1980s the federal government began to engage in extensive Medicaid policy making, including several expansions of eligibility for children and pregnant women, welfare reform that expanded

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[20] Massachusetts has two distinct programs, these are combined in this analysis.

Medicaid eligibility, Medicare reform that extended Medicaid eligibility to low income Medicare beneficiaries, and broadening of the minimum coverage requirements for children. In part, the states responded to these changes by incorporating even more services under Medicaid – off loading the cost of those services from programs funded solely with state funds – and by using provider tax and/or donation programs that have the effect of increasing the effective federal share of total program costs. Most such policy making resulted in huge expenditure increases over very short horizons. It is unlikely that these policies would be reflected in forecasts discussed here.

Table 7 and Table 8 show comparative data at 12 months before the end of the fiscal year (the last forecast before any portion of the actual expenditures are experienced), The number of years with positive and negative errors is similar to those in Table 5 and Table 6 – 7 negative average errors and 7 positive (Table 7); and 8 years with more than 50% of states with negative errors and 6 with fewer than 50% (Table 8). However, the cumulative columns reveal a bias towards negative errors. Table 7 shows only 5 years in which the cumulative errors are positive, as compared with 9 years of negative cumulative errors. Table 8 shows only 1 year where the cumulative percent of states with negative errors is below 50%. Over this 14 year period the cumulative percent of states with negative forecasting errors is 53.3%.[21]

These results are consistent with the broader view that budget officials are risk averse. Overestimation of expenditures serves the same ends as underestimation of revenue, to establish a cushion against higher risk error. While errors that lead to surpluses may be viewed unfavorably by those who could have allocated funds to other purposes. The alternative of shortfalls can lead to financial crisis. This analysis supports the view that Medicaid forecasters are more averse to financial crisis.

It is interesting that these results are not found with the federal districts and territories. These data demonstrate a bias for underestimation. The unweighted average forecast error for these six districts at the beginning of fiscal years is positive for 10 of 14 years with the cumulative average error positive 13 of 14 years (Table 7). While there are an equal number of years in which the majority of these districts make negative and positive forecasts at this horizon, cumulatively over 14 years, 47.6% of federal district forecasts overestimate expenditures (Table 8). Federal districts do not have the same bias towards overestimation as states, and they may be biased towards underestimation. No explanation of this alternative bias is available at this time.

Table 7

	States		Federal	
Year	UnwAvg	CumAvg	UnwAvg	CumAvg
1982	-5.0%	-5.0%	-6.3%	-6.3%
1983	-2.1%	-3.5%	13.0%	3.4%
1984	-5.0%	-4.0%	33.3%	13.3%
1985	-2.0%	-3.5%	1.3%	10.3%
1986	0.2%	-2.8%	-4.0%	7.5%
1987	5.1%	-1.5%	0.6%	6.3%
1988	2.4%	-0.9%	8.8%	6.7%
1989	0.8%	-0.7%	-4.9%	5.2%
1990	2.9%	-0.3%	-3.5%	4.3%
1991	11.5%	0.9%	41.0%	7.9%
1992	4.8%	1.2%	38.5%	10.7%
1993	-4.1%	0.8%	43.8%	13.5%
1994	-4.3%	0.4%	24.8%	14.3%
1995	-0.1%	0.4%	1.3%	13.4%

UnwAvg. = Unweighted average.
CumAvg. = Cumulative average.
Percent error 12 months prior to fiscal year end.

Table 8

	States		Federal	
Year	% <=0	Cum. %	% <=0	Cum. %
1982	75.5%	75.5%	80.0%	80.0%
1983	73.5%	74.5%	20.0%	50.0%
1984	88.0%	79.1%	16.7%	37.5%
1985	58.0%	73.7%	33.3%	36.4%
1986	52.0%	69.4%	83.3%	46.4%
1987	30.0%	62.8%	66.7%	50.0%
1988	36.0%	58.9%	33.3%	47.5%
1989	42.0%	56.8%	66.7%	50.0%
1990	34.0%	54.2%	66.7%	51.9%
1991	22.0%	51.0%	33.3%	50.0%
1992	28.0%	48.9%	16.7%	46.9%
1993	84.0%	51.8%	50.0%	47.1%
1994	70.0%	53.2%	16.7%	44.7%
1995	54.0%	53.3%	83.3%	47.6%

Hypothesis 2: States manipulate fiscal year end accounting data to improve forecast outcomes.

State motivation for this practice rests with the fact that, in the case of Medicaid, the forecast coincides with the budget. State officials may be motivated to ensure that the actual expenditures coincide with planned expenditures. In the case of Medicaid, ordinary fiscal management may not be sufficient to attain such results. Most Medicaid expenditures are made through claims processing, not discretionary or quasi-discretionary expenditures. In most states, claims processing is automated. So, adjusting year end expenditures to match budget plans would involve causing claims processing to accelerate or decelerate.

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[21] This result may be affected by beginning arbitrarily in 1982, the first year of data availability.

Medicaid programs are operated by state agencies. Executives of these agencies are responsive to state officials, including state governors and state legislators, because they report to these officials. So, the motivation to appear correct would be a feature of state budgeting. There is no particular advantage of manipulating expenditures reported to the federal government to achieve the illusion of forecast accuracy. Presumably, the illusion is achieved by either delaying or accelerating payments in the last quarter of the fiscal year, with a mirror image change in expenditures in the next fiscal quarter. So, the illusion should appear in data from those states whose fiscal year coincides with the federal fiscal year, but should be absent from data with other fiscal years.

Table 9

	Average Error	States	Obs.
States:			
April	6.55%	1	14
July	6.54%	46	643
Combined	6.54%	47	657
September	4.45%	1	14
October	5.46%	2	28
Combined	5.12%	3	42
Federal Districts	20.9%	6	84

To evaluate this hypothesis absolute percent error for each state are pooled across the 14 years and then averaged within groups for each fiscal year end. Federal districts are reported separately. The absolute error is evaluated because the direction of error is not at issue. The errors are pooled because of the low number of states whose fiscal year coincides with the federal fiscal year. There are 46 states with fiscal years beginning in July, 1 beginning in April (New York), 1 beginning in September (Texas), and two beginning in October (Michigan and Alabama). The federal fiscal year begins in October. The pooled observations are not independent, so no statistical analysis is attempted.

For the 47 states with fiscal years beginning more than a month off of the beginning of the federal fiscal year, the average absolute error for 647 separate fiscal years (Arizona is not reported for 1982) is 6.54%. If Texas (fiscal year beginning in September) is included with this group, the average drops to 6.50%. For the two states with fiscal years matching the federal fiscal year, the average absolute error for 28 separate fiscal years is 5.46%. If Texas is included with this group, the average drops to 5.12%. Thus, the range of difference between these errors is between 1.04% and 1.42% depending on which group Texas is included with. These results weakly support the view that states manipulate year end activities to create the illusion of budgetary accuracy.

Hypothesis 3: Forecasts are more accurate when forecast models more explicitly reflect the elements generating the forecasted series.

Data are not available to evaluate each of the 10 sub-hypotheses enumerated. However, two sub-hypotheses can be evaluated. The first sub-hypothesis specifies that forecasts will be more accurate when states explicitly account for the transformation between service date and payment date. This sub-hypothesis is evaluated using the pooled 14 year absolute forecast errors as discussed with the second hypothesis. Identification of states who explicitly account for service date to payment date transformation is found in data determined by Lower. Results are shown in Table 10. States who focus on "payment date" do not attempt to evaluate service date (accrual) events, while those who forecast "service date" do. (No federal districts are reported in the Lower study.) A third group of states evaluate service date data some times. Based on these pooled errors, there is no reason to anticipate that accounting for the service date events improves forecast accuracy.

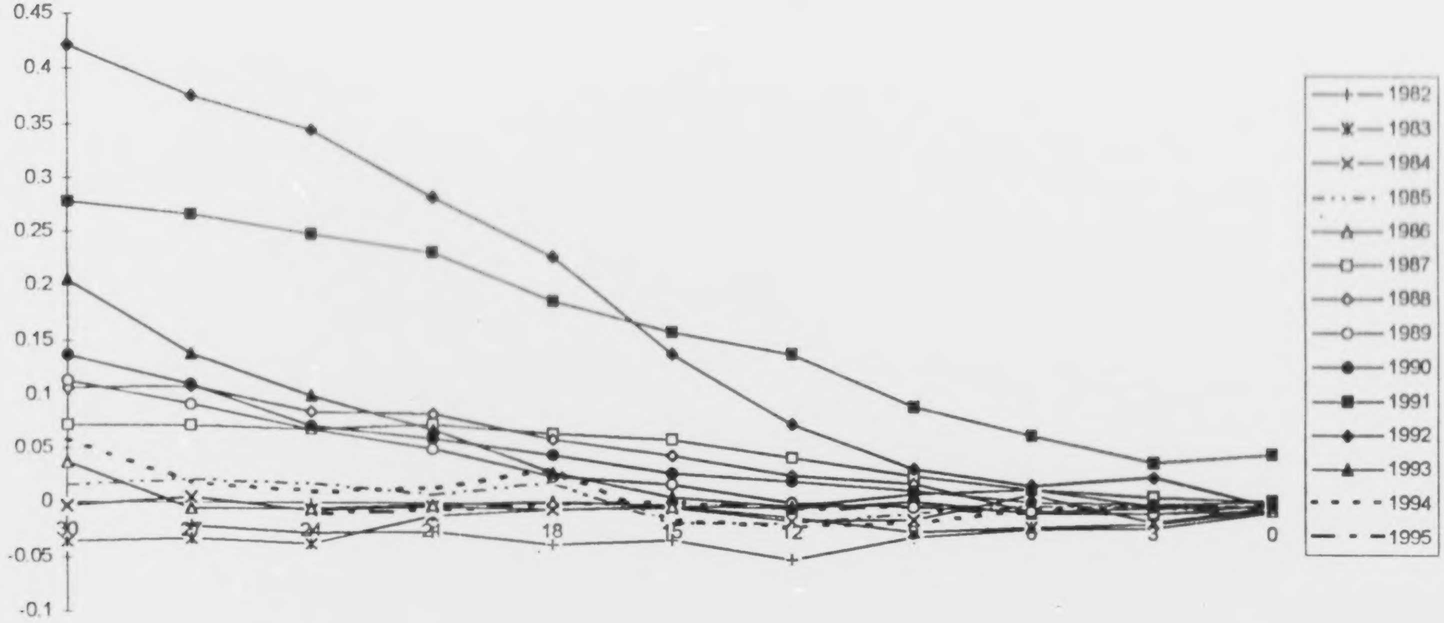
Table 10

	Average Error	States
Payment Date	6.10%	28
Service Date	6.13%	9
Mixed	7.61%	6

However, it may be that the time period between the earlier forecasts and the date of the Lower survey invalidates the evaluation using these pooled errors. Table 11 shows comparable results with errors pooled

Hypothesis 4: Forecast accuracy is affected by numerous specific technical elements of the forecast.

Percent Error By Months Before the End of the Fiscal Year



from 1992 through 1995. As with Table 10, there is no evidence that forecast models that account for service date events are more accurate than those that do not.

Table 11

	Average Error	States
Payment Date	5.75%	28
Service Date	6.10%	9
Mixed	6.23%	6

The third sub-hypothesis specifies that forecasts made within the framework of the recommended PUC model will be more accurate than those that are not. This hypothesis is of special concern as HCFA requires states to produce and submit data on the HCFA-37 that reflects the PUC model, whether or not they use this model. If the hypothesis is incorrect, states may be required to conduct unnecessary analyses and forecasts for the sole purpose of completing arduous paperwork required by HCFA.

The evaluation of this hypothesis is based on the same 4 year pooled errors as used in Table 11. Identification of states that use the PUC model is based on preliminary data from a survey of state Medicaid agencies occurring in 1997. At the time of this paper, the survey has received 35 responses out of 56 Medicaid programs. Results are shown in Table 12. Based on these results, there is no evidence that use of the PUC model improves forecast accuracy.

Table 12

	Average Error	States
Use PUC	5.65%	13
Do not Use PUC	5.81%	20
Federal	8.97%	2

Hypothesis 4: Forecast accuracy is affected by numerous specific technical elements of the forecast.

Most aspects discussed here are still to be evaluated. Figure 1 demonstrates the relationship between forecast accuracy and time. Each line demonstrates the change in forecast error over the period beginning with the first forecast submitted to HCFA and ending with the fiscal year end. Data do not always converge to zero because the HCFA-37 was not required to match the HCFA-64 (accounting data) for past periods prior to 1992. It is not very surprising that forecasts become more accurate as the forecast horizon diminishes. It is interesting how little accuracy improves over time in many years. The chart shows only minimal improvement in average error in forecasts for 1982 through 1986, 1994, and 1995. These results arise because of relative accurate forecasts at the longest horizons. A review of state specific data (not shown here) reveals that accuracy in earlier periods arises from the cancellation of forecast errors between states, and that there is a convergence towards forecast accuracy over time.

CONCLUSION

This paper is a interim report of research in progress. The report shows that Medicaid forecast data can be used to evaluate applied forecasting. Some tentative conclusions include:

State forecasters use asymmetrical loss functions in selecting forecasts to report. Forecasters are more averse to underestimation of expenditures than to overestimation.

Federal district and territory forecasters are not averse to underestimation and may be averse to overestimation.

States may manipulate fiscal year end activities to ensure the accuracy of fiscal plans.

There is no evidence the explicitly accounting for some details of data generating events – specifically, the transformation between service date events and payment date events – results in increased forecasting accuracy.

There is no evidence that the HCFA recommended Price x Utilization x Caseload model of data generation produces more accurate forecasts.

Forecast accuracy is associated with length of horizon.

These results support the view that further analysis of these data will generate other interesting findings that can improve the understanding of applied forecasting.

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Consumer Health Accounts: What Can They Add to Medicare Policy Analysis?

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Introduction

Over the past few years the Office of the Actuary of the Health Care Financing Administration (HHS) and the Inforum group at the University of Maryland have been investigating the relationships between the health care sector and the rest of the economy. One path of research has emphasized the fiscal consequences of large spending increases for federal medical programs, like Medicare. Beginning in 1995, outlays for hospital insurance (Medicare, part A) exceeded earmarked revenues and projections suggest that outlays and revenues will continue to diverge by ever-widening amounts.[2] Actuarial projections of growth in Medicare part B, which is financed out of general revenues, also show growth faster than federal tax revenues. When Medicare spending rises faster than federal tax revenues, any or all of three consequences occur:

1. The federal deficit rises.

2. Other spending programs are cut so the deficit does not rise.

3. Payroll or other taxes are raised, so that other spending programs can remain on their original funding paths without increasing the deficit.

All of these occurrences have macroeconomic consequences, and influence the industrial structure of employment and output. Thus, in an indirect way, federal outlays related to medical care can have a large influence on a wide variety of industries. In Monaco and Phelps (1995) we showed that a large increase in the federal deficit from increases in Medicare spending shifts economic activity away from industries with high measured productivity, like manufacturing and agriculture, to industries with low measured productivity, like health care and business services. In addition, our research has shown that the combined projected social insurance deficits using SSA/HCFA middle-case scenarios over the next 50 years would require a pay-as-you-go payroll tax rate of 32 percent in 2050 to keep the federal budget balanced. This is more than double the current rate (Monaco and Phelps (1997)).

Actuarial projections of Medicare spending rise for two distinct reasons (Monaco, Phelps, and Mulvey (1996)). First, in the short run (through about 2011), the projected Medicare "deficit" is driven primarily by rapidly-rising spending per beneficiary. After 2011, actuarial projections of growth in spending per beneficiary slows, but a rapid rise in the number of beneficiaries from retirement of the Baby Boomers results in continued growth in Medicare spending.[3] The recent budget compromise has moved the projected Medicare Part A trust fund insolvency date from 2001 to 2007. This was done partly by reducing provider payments per beneficiary--at least partially addressing the first problem. However, the improvement in the outlook of the Part A trust fund was accomplished primarily by reassigning home health liabilities from Part A of the program to Part B. While this improved Part A solvency, it did not reduce the projected overall Medicare deficit. Little was done to address the longer-term financing problems arising from the coming demographic shift. Presumably, longer-term issues will be addressed by the yet-to-be-appointed Medicare commission. Thus, even with the recent reductions in the near-term path of Medicare spending, it is clear that Medicare policy will remain an important issue throughout the next several years.

What Determines Medicare Spending?

The Medicare program was designed to cover a significant portion of the cost of medical care for the elderly (over 64) and those with disabilities or end-stage renal disease. Broadly speaking, Part A of Medicare covers hospital services, while Part B covers physician services. Conceptually, Medicare is an insurance program that, after some deductibles and copayments paid by the beneficiary, directly reimburses providers for each kind of treatment.[4] The important point for our purpose is that the amount of Medicare spending in any year is not "capped" at any level. Given the reimbursement structure, Medicare outlays are actually determined by the usage of covered Medicare services by the beneficiary population. In short, Medicare outlays are determined by the demand for medical services.

In most of our research, we have concentrated on analyzing the economy-wide implications of projected

Medicare outlay paths without specifically forecasting the Medicare outlay paths ourselves. Typically, we have used projections of Medicare outlays from the Office of the Actuary (HCFA), which we put into a model as exogenous assumptions. We then ran the model under different assumptions concerning feedback between the health sector and the rest of the economy, and compared the results of the various simulations.

The model we've used and developed is a comprehensive, consistent, structural econometric model estimated on historical data from about 1960 through 1994, with a simulation horizon of one to fifty years. In general, the model accounts for relationships among macroeconomic variables such as government deficits, interest rates, exchange rates, inflation, and unemployment, as well as the input-output relationships among various industries that make up the economy. For example, the model accounts for the tendency of larger government deficits to be accompanied by higher real interest rates and exchanges rates, leading to lower spending on autos, new houses, and agricultural goods (especially sensitive to exchange rates). It also accounts for the reduction in the amount of steel production in the economy that accompanies the reduction in automobile and construction activity, as well as the reduction in the output of the chemical industry as a result of the reduction in fertilizer demand that accompanies the reduction in agricultural production.[5]

A key part of the model is the complete consumer demand system, which estimates consumer spending by 80 types of goods/services, allowing for income effects, demographic effects, own price, and cross-price effects (henceforth, goods and services will be called "goods"). We refer to a complete consumer demand system to emphasize that the system accounts for all consumer spending, rather than just a part. The theoretical basis for the demand work is standard consumer demand theory. Consumer demand theory begins with a utility function, which translates amounts spent on each good into consumer satisfaction. As a quick review, the theory holds that consumers seek to maximize their total utility by allocating spending across all goods subject to a budget constraint. The theory makes a few other key assumptions as well: (1) consumers prefer more of a good to less of a good, (2) consumers have complete preferences, that is, they can compare and rank all combinations of goods, and (3) consumer preferences are transitive. In addition, assuming spending on all other goods remains the same, additional equal amounts of spending on any single good eventually yield a smaller and smaller amount of satisfaction. This last concept is the traditional "diminishing marginal utility" assumption.[6]

In the typical empirical implementation of the complete demand system, the demand for medical services is treated no differently from other goods. Consumer spending for medical services is assumed to be a function of the relative price of medical care and the total income to be allocated, which includes government cash and non-cash transfers. In most cases, other determinants are allowed as well. For example, in the demand system currently used by our macroeconomic model, consumers decide how much hospital services, physician services, etc. they demand on the basis of their income, the prices they must pay, and the age-structure of the population. Thus, we allow for the fact that older age groups tend to consume more medical services, all other things equal.

In many implementations of complete consumer demand systems, medical services spending is divided into several categories. In the current version of our model, there are separate categories for hospital services, physician services, nursing home services, and dentists and other medical practitioners. One innovation in our ongoing line of research allowed Medicare policy to affect the level of consumer demand for medical care goods (Janoska (1997)). The view embodied in our current consumer spending equations is that a policy decision to raise or lower Medicare spending influences the consumer demand for medical services by raising or lowering the prices faced by a group of consumers. Thus, when the implied government subsidy for medical care is made more generous, holding everything else equal, we reduce the price of hospital services facing consumers. As a result, Medicare beneficiaries typically tend to consume more hospital services. Our estimated parameters suggest that, as a generalization, the own-price elasticity across all of the medical services categories (after trying to account for the effect of Medicare) is around 1, i.e. a 1 percent increase in the price of medical services relative to all other goods reduces demand by about 1 percent.

When a complete consumer demand system is embedded in a larger, comprehensive general equilibrium model, the model can be used to generate forecasts of Medicare outlays, while simultaneously allowing for the feedback effects that rising Medicare outlays generate on the rest of the economy (described above). The model can also be used to evaluate impacts of other projections of Medicare spending by overriding endogenous consumer health spending. With its endogenous demand system, the model can indicate of the path of Medicare spending over the next fifty years, accounting for the rising number of people over age 64, the rising levels of income, and the assumed "generosity" of the Medicare program, while simultaneously allowing for the feedback between Medicare outlays and the rest of the economy.

Data Problems in Measuring the Medical Services Sector

Simply applying consumer demand theory to the available national accounts consumer spending data is fairly straightforward and has proved very useful for policy analysis and forecasting in nonmedical areas. However, lately we and several other researchers have begun to question whether the data typically used to estimate a system of complete demand equations meet the requirements for a proper application of standard theory. Questions have arisen especially in the area of consumer health spending, where the current structure of national account data emphasizes which providers receive consumers' dollars, rather than what actually is provided. To consider the question more fully, it is useful to consider briefly how the consumer spending data in the national accounts are derived.

Consumer spending data most often used by researchers estimating complete consumer demand systems appear in the published National Income and Product Accounts (NIPA).[7] The tables show the composition of consumer spending by type of expenditure; for example, consumer spending on new cars, used cars, food, clothes, jewelry, barbers' services, hospital services, physician services, dentist services, etc. The data underlying these estimates of consumer spending by good/service are, for the most part, actually *collected* from the institutions receiving the dollars, e.g. Wal-Mart, Home Depot, barbershops, hospitals, and nursing homes. These institutions are actually consumer-goods providers. The data in table 2.4 (consumer spending by type of expenditure) is constructed by knowing what these providers typically sell, supplemented by information from other consumer surveys and trade association data.[8]

In most of the cases, data are only available for nominal spending. Few indicators of inflation-adjusted consumer spending are available directly. For example, the "benchmark" estimate of consumer spending on physician services in nominal dollars comes from the Census of Service Industries. Between benchmarks, data are from an annual survey of services and from HCFA data, and for quarterly data, supplemented by a "judgmental trend."[9] To calculate real consumer spending by type of expenditure, the nominal figures are deflated by price indexes. For the vast majority of the expenditures, the relevant price indexes are consumer prices. To calculate the "real" value of consumer spending on physician services, the nominal estimates prepared from the above-mentioned sources are divided by the consumer price index for physician services.

No data set is perfect. The key question in using any data set is simply whether the data are good enough to support the structure that will be built on them. Our current concern with the NIPA consumer spending data as a support for consumer demand theory centers on two somewhat-related ideas. First, conceptually, medical services data in the NIPA, like almost all services data in the NIPA, tell us where the consumer dollar is spent, not what the consumer dollar buys. Secondly, recent research has suggested that consumer price indexes for medical care have substantially overestimated the amount of inflation in medical care, and so have underestimated the amount of real services provided by medical care practitioners.[10] Each of these problems potentially has an enormous effect on the quality of the conclusions that can be obtained by a demand system approach to medical care consumption, and, by implication, to all consumer spending.

Spending on Consumer Goods versus Spending at Consumer-Goods Providers

The national accounts tell us where the consumer dollar for health goes -- which providers get the money. It does not, like data for some other goods, immediately tell us what consumers bought. In this sense, hospital services are treated the same way as barbers' services. In both cases, the "good" purchased by the consumer is really measured by the spending that occurs in a particular kind of "store." This distinction poses problems for consumer demand theory, which is almost always stated in terms of the demand for distinct, separable goods and services that each yield distinct bundles of satisfaction. Thus, the available data do not exactly match the requirements of theory.

Pragmatically, when researchers apply consumer demand theory to existing time-series of inflation-adjusted consumer spending by good, they generally assume that using data on where consumers spend their money is a close approximation to the kinds of goods that are actually bought. For the most part, this is true and we would not expect our price and income elasticities to be exceptionally sensitive to small deviations of the data from the "true" data. Common sense allows us to be reasonably sure that substituting spending at barbershops for the true "haircut" category does little violence to the estimated price and income elasticities for haircuts. This is because, in general, we think we have a fairly good idea of the type of service provided in the barber's shop. The possible range of prices for haircuts, and the range of personal appearance services -- shaves, perms, pedicure, manicure, etc. -- is really quite narrow. We are willing to believe or assume that, given a constant consumer utility function, a real dollar of barbers' services conveys a given amount of satisfaction over time. In other words, we are willing to believe that the satisfaction derived from any particular good purchased at a barber's shop is quite close to the average amount of satisfaction across all possible goods purchased at a barber's shop.[11]

These implicit assumptions aren't quite as tenable for consumer spending data for hospital and physician services. Here the range of possible services is very wide. The range suggests that a dollar's worth of hospital spending may be associated with varying degrees of satisfaction, depending on exactly what the dollar bought. For example, a dollar's worth of satisfaction may be quite large as part of a visit the emergency room to have a tetanus shot, or very small, as a part of a complicated operation. Thus, it is hard to be content, as we are in the case of barbers' services, to argue that the "average" amount of satisfaction from a dollar spent on hospital services is reasonably representative of the satisfaction derived from a dollar spent on any arbitrary good purchased at a hospital.[12]

Beyond these reservations, applying consumer demand theory to the medical services categories in the national accounts violates a basic part of the paradigm. In standard consumer theory, a good may be a substitute or complement with any other good, however, it may not be both. Yet because medical services data are largely shown by provider, aggregate consumer spending on hospitals and physicians are almost certainly both at the same time. For example, physicians work in hospitals, but bill separately. Thus, for an operation requiring a hospital stay, physicians and hospitals are complements. However, there are also cases in which a series of in-office visits can take the place of a hospital stay; physicians and hospitals are substitutes. Similar kinds of examples can be constructed across all of the categories of national income account health spending. These problems appear to be unique to the medical services categories, owing to the institutional arrangements that have developed for paying for medical care. If barber shops billed each patron for using a chair and electricity, etc., while the barber billed each patron for "haircutting," we would have a similar situation to that of hospitals and physicians.

The implication of the last issue is exceptionally serious for good estimates of the price, income and age-structure relationships that underpin the standard consumer demand approach. Shifts in treatment regimes across national income account categories will make it impossible to estimate reliable price, income, and age-structure relationships. To the extent that empirical models rely on these parameters to help make forecasts or are used in policy analysis, the analyses are based on shaky ground.

The discussion of the last few paragraphs has been somewhat abstract. However, the key points can be made quite simply. For many services, national accounts data substitute data measuring where consumer spending occurred in the place of what was actually bought. When the establishment sells a narrow range of goods, this is not a particularly significant problem. As the range of goods and their prices widens, the approximation worsens progressively. The range of services provided by hospitals, physicians, and other medical care institutions is exceptionally wide, so the approximation of provider spending to goods spending needed for a proper application of consumer demand theory is likely quite bad.

While some of these criticisms apply to almost all consumer spending service accounts, two other features of medical care spending make this categorization problem especially serious. First, spending is an extremely large part of the total consumer spending bundle; about 17 percent in 1996. Thus, because the health categories comprise a large portion of spending, forecasts and scenarios based on poor estimates of price and income elasticities will be influential in the overall economic analysis. On a related note, because public funding of medical spending accounts for about a third of overall health care spending, and has an enormous influence on the government budget, accurate forecasts and robust estimates of the underlying demand parameters are essential to good policy making.

Better Estimates of Medical Prices

It has become popular recently to point out the limitations of the current medical price indexes in the consumer price index measurement program. The most fundamental issue facing the measurement of prices in the health care sector is accounting for the changes in the quality of the care provided. Conceptually, the inflation-adjusted spending figures and prices that should be the basis of price and income elasticities of the consumer demand approach should be "quality-adjusted." Consider how the Bureau of Labor Statistics (BLS) would treat an innovation embodied in a new car, such as more "bump resistant" bumpers. Because this improves the car, the CPI for new cars would be lowered slightly, so that each nominal dollar spent on a new car would result in a slightly higher value for "real" new car spending than would have been the case without the adjustment. The BLS attempts to account for the improved quality of the car.[13] In general, when the "quality" of the good in question improves, we expect that the price measures used to deflate the nominal purchases (the only available data) will be calculated in such a way as to make clear that the price of a constant-quality good is lower.

Although measuring quality change for goods is hard, measuring quality change for many services is nearly impossible. For the medical services sector, the task is made even more problematic because of the tendency to view prices from the perspective of who is providing services rather than what services are being provided. Thus, there is a CPI for physician services and another for hospital services, but not one for, say, heart attacks. The major problem with even attempting to measure quality change under the current structure of the CPI (and NIA consumer spending) in the medical services sector is that we would need to have some kind of outcomes data. But hospitals and physicians could be doing very different things over time, depending on the disease incidence, the age-structure of the population, and a host of other factors. Thus, the "outcomes" from a dollar's worth of spending in hospitals would be nearly impossible to measure, because it depends on what was done at the hospital. It is, however, the latter kind of CPI -- CPI adjusted for outcomes quality -- which is most interesting and useful from the point of view of consumer demand theory.[14]

For many types of services the assumption of little or no quality change is, to a first approximation, probably appropriate. In the case of barbers, we do not take the trouble to inquire about whether the "haircut" was successful or not. We generally assume that they are all successful (a haircut = a good haircut), or, more generally, that the probability of a satisfactory haircut is reasonably constant over time (90 percent of the haircuts are good). Either is fine for time-series analysis. But the probability of satisfaction from a dollar spent on medical services of any type is probably rising. At the very least, mortality data by disease suggests this is so.[15] For example, between 1968 and 1991, the age-sex-adjusted central death rate declined from 1079 per hundred thousand to 778.9, a decline of almost 25 percent. Looking at the ten major causes of death, the first and third (Heart disease and Vascular disease) showed annual percentage declines during this period of 2.2 and 4.3 percent respectively. Only the fifth and tenth leading causes (Respiratory and Other) showed any significant increase. The result of these improvements was that life expectancy at birth for males increased by 5.3 years and by 4.7 years for females. The data above offer the strong implication that, generally speaking, the probability of any dollar spent on hospital or physician services yielding satisfaction has risen over time. This is nothing more than saying that medical care, per dollar spent, is getting better: an inflation-adjusted dollar spent on hospital services for the treatment of a disease in 1990 has a greater probability of yielding satisfaction than a dollar spent in 1980 on the same disease.

To recapitulate, we can state the five major points in our argument.

1. Federal medical outlays depend on the consumer demand for medical services.

2. Comprehensive general equilibrium models -- those incorporating macroeconomic feedbacks, as well as the relationships among industrial sectors in the economy -- require a complete system of consumer spending. This type of model relies on national account data because it is complete and exhaustive of consumer spending.

3. There are serious problems applying the standard consumer demand paradigm to the existing national accounts data for medical services. Conceptually, the data by providers is not appropriate for consumer demand theory. In addition, even if the data were categorized in a way useful for consumer demand theory, lack of quality adjustment makes it nearly impossible to estimate good price and income elasticities. Together, these problems compromise the stability of estimated price and income elasticities for health-care components.

4. Inappropriate income and price elasticities -- even in a model that captures all relevant feedbacks -- lead to poor forecasts of consumer demand for medical

services.

5. Poor forecasts of the consumer demand for medical services can lead to poor forecasts of federal medical services liabilities, and reduce the effectiveness of the economy-wide approach to analyzing federal medical services policy. We have concluded that our own economy-wide approach -- based on NIPA data -- cannot be reasonably used to differentiate the separate economic effects of medical price changes and the quantity of medical care used in the economy.

Another Approach to Accounting for Consumer Health Spending

As mentioned above, the national account data for consumer spending on health services focuses on providers. In contrast, what consumers typically demand is not hospital or physician services per se, but treatment for a specific condition. The treatment path can be quite short and limited to a single provider, like a single trip to the general practitioner for an immunization or an antibiotic. However, the treatment path could be longer and much more complex, as in a treatment requiring initial in-office physician visits for diagnosis, an in-patient hospital stay for an operation, a set of follow-up physician visits, and/or a stay in a short-stay rehabilitation institution. To try to sidestep many of the problems posed when the standard consumer demand paradigm is applied to existing medical services data in the national accounts, we can try to recast the accounts by type of disease or condition treated.

Looking at spending by condition treated rather than by where the medical services dollar is spent appears to resolve many of the issues discussed above. For example, treatment for diseases of the circulatory system is a fairly well-defined, if somewhat aggregated consumer good to which standard consumer theory can be applied. It is sufficiently well-defined to avoid the problem of being a substitute and complement with any other good simultaneously. In short, it is a "good" in a way that none of the consumer spending categories for medical services currently in the national accounts are.

Like Triplett (1997), we recommend developing a matrix that maps health spending by provider into the treatments that completely exhaust consumer medical care spending (one category would likely be "all other spending, not elsewhere classified."). We would then use the "treatments" data in the place of the currently-used provider data to estimate a complete consumer demand system. This approach would lead to estimates of the income and price elasticities of treatment for disease X, where X could be a very aggregated category (diseases of the circulatory system) or very disaggregated (acute myocardial infarction). These elasticities would, in contrast to the currently estimated price and income elasticities, be economically meaningful.

Benefits of the "Treatments" Accounts

What benefits do we get from examining health spending by disease categories rather than provider categories? First and foremost, the approach should yield more reliable estimates of important price and income elasticities on which projections of consumer medical spending are based. Thus, it is likely that general equilibrium models would produce better (more accurate) forecasts of consumer health spending and Medicare liabilities than they currently can. The policy-analysis potential of this treatments approach is quite broad, allowing evaluation of alternative changes in government subsidies of medical health demand by the elderly. An additional advantage is that consumer health spending can be disaggregated into far more detailed goods than the current groupings of providers (hospitals, nursing homes, physicians etc.)

Secondly, a treatments approach naturally facilitates splitting the nominal data into its price and quantity components. Estimating the quantity and quality of treatments is a daunting task, but the treatments approach at least provides an outlet and a framework for incorporating current research about treatment efficacy into the national accounts. Several recent papers suggest that the conceptual and data problems are manageable with a treatments approach, although not easily so. Cutler *et. al.* (1996) discuss the issues with respect to acute myocardial infarctions (heart attacks), and show that after accounting for the improvement in outcomes -- quality change -- the "price" of treatment has fallen by about one percent a year since 1984. The flip side is that the "quantity" of heart attack treatment has risen much more rapidly than had previously been thought.

The work of Cutler *et. al.* as well as those cited in Graboyes (1994) has several important implications: (1) Medicare spending has probably been more

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"productive" than had previously been thought, (2) the "true" cost of living with respect to medical care is probably much lower than official estimates suggest, and (3) measures of real economic activity like GDP have probably been understated. The treatments approach allows these implications to be incorporated into the national accounts data.

The possibility that a different framework for consumer spending accounts might lead to a different view of the role of medical care in the economy raises broader policy issues. Under the current situation, without knowing the treatment composition of medical consumption, it is difficult to account for the costs and benefits of higher levels of medical spending. Thus it is difficult even to partially answer the most basic question posed in the early 1990's health care reform debates: what is the appropriate amount of health care spending in the economy? Consider only Medicare spending for the moment. When we are not sure what treatments the elderly are demanding, it is hard to design our policy to improve overall health with some cost effectiveness. Without some definition of the "quantity" of treatment and the cost per unit of quantity, policy is reduced to the very indirect expedient of targeting only the provider income flows -- largely the current situation.

But targeting provider income flows can be a poor mechanism for enhancing the effectiveness of Medicare policy. The elderly obtain heart bypasses, hip replacements and the like to treat their health problems. These health goods are composed of different combinations of inputs, like drugs, and providers' services (physicians' services, inpatient and outpatient hospital services, nursing homes, and others). Medicare does not cover all types of health care costs equally. For example, Medicare does not typically cover drugs purchased out of the hospital or nursing home costs. Thus, when policy makers squeeze Medicare outlays by provider, they are increasing the direct costs facing consumers differentially across treatments that require different mixes of covered and not-covered provider services. Without knowing the different provider combinations that produce different health goods, prices of more cost-effective treatment paths may be raised more than others. An interesting corollary to this point is that programs that subsidize some providers and not others are likely to induce a number of distortions and be economically inefficient.

Focusing on provider payments without also considering the services provided implicitly promotes the notion that provider income can be reduced without reducing the volume of services per beneficiary. Generally, provider payments are made for services rendered. The reduction in provider payments means either the volume of services rendered will be reduced, or the cost per service rendered will be reduced. Only if Medicare providers were reaping economic rent (excess profits), would the reduction in "provider payments" not lead to a reduction in either the volume or quality of services rendered. The idea that we can reduce provider payments without affecting services is inextricably bound up with the idea that Medicare providers are earning "excess" income, which we can reduce without changing their behavior.[16] If that is not true, then changing provider payments changes provider behavior.

Whether cutting provider payments and services is a good idea or not depends on an assessment of the total costs and benefits of the Medicare program. In other words, if the total costs of the last Medicare dollar spent were less than the total benefits, then cutting provider payments is not a good idea. The chief difficulty with applying this test to Medicare is developing estimates of the total costs and benefits. Among the costs to be considered would be the effect of spending on the federal deficit, and the consequent effects on interest rates, the value of the dollar, employment, and production. Also included would be the forgone benefits of having not spent the dollar on other programs. Among the benefits to be considered would be reductions in mortality and morbidity, and, the investment benefits that accompany learning by doing. Some of these costs and benefits can be determined only by looking at the medical sector; others require a comprehensive, economy-wide view. In either event, a better framework for evaluating the medical services sector will provide both better economy-wide analyses as well as analyses of the medical care sector alone.

A crucial benefit of the treatments approach is that it provides a natural conduit for considering disease incidence, treatment costs, and treatment efficacy. For forecasting purposes, projecting disease incidence by age, the costs of each treatment, and the age structure of the population would take center stage.[17] For example, projections of a growing group of the very old should correspond with projections of higher demand for treatment paths in which nursing homes are a very large input. Thus, a consumer goods-based view of Medicare spending might encourage a broader view of federal medical policy. If it were important to reduce future Medicare spending, we might begin by actually raising current spending on targeted research at the disease treatment categories accounting for a high percentage of outlays. Or policies could be designed to encourage prevention or early detection. For example, diseases of the circulatory system accounted for 18 percent of inpatient hospital Medicare reimbursements in 1995. One policy might aim to reduce the incidence of such disease through diet, exercise, and regular tests which might result in early diagnosis and implementation of preventive steps.

The benefit of having a consumer treatment approach is to make these tradeoffs among disease categories explicit because we will now be able to see the flow of subsidies to different diseases and their differing outcomes.. This hardly eases the job of the policy maker. In fact, by explicitly acknowledging the differences across consumer health goods categories, policy making will probably get harder, because the conflicting resource requirements across treatment types will be explicit. However, it is important to remember that these conflicts exist already; they are simply more difficult to see under the current data treatment.

A Small Beginning

Recasting the accounts this way is not an exceptionally novel idea (see Triplett (1997) for related arguments) . Several researchers have distributed total personal health care spending by disease/condition. The seminal work by Cooper and Rice (1976) has been extended by Hodgson (1984, 1997)). Table 1 shows the distribution of total U.S. personal health care spending over 18 aggregated ICD-9-CM categories for 1980 and 1995. For a longer historical perspective, data are also presented for 1972, but, since they use an earlier ICD-7 coding system, the data are not strictly comparable for all categories. It is also important to note that the share of spending that was not allocated varies across all three time periods. The major source of unallocated costs comes from physicians and other professional services and nursing home care.

The 18 ICD-9-CM categories show a fairly high degree of concentration of spending and a high degree of stability of spending shares and their trends over time. Together, these five categories (Diseases of the Nervous, Circulatory, and Digestive systems, Injury and poisoning and Mental disorders) account for 55 percent of all spending, with individual shares ranging from 8-to-17 percent. Even a cursory look indicates some interesting characteristics that suggest amenability to forecasting.

Circulatory system diseases has the largest share (16.9 percent in 1995) and the largest increase in share (14.5 percent in 1972) of any of the top five categories. In 1980, the only year with separate over- 65 data, approximately two-thirds of spending on circulatory diseases go to the over 65 population, accounting for almost 30 percent of the total spending for this group.[18] On the other hand, the data for digestive diseases in Table 1 show a different picture. Digestive diseases accounted for a declining share of spending , from 14.8 percent in 1972 to 11.4 percent in 1995. Digestive diseases are a somewhat special case, however, since they are heavily influenced by trends in dental spending (accounting for 48 percent of digestive-disease spending in 1995). Only one-sixth of total spending on digestive diseases was for the over-65 population. The different age characteristics of circulatory and digestive diseases suggest that spending growth for these categories will be decidedly different as the Baby Boomers age.

Relative price movements will also affect the evolution of spending in these categories. Relative prices are affected by productivity (technology) and government subsidies. It is interesting to note that the Medicare subsidy of physician and hospital services is more important in circulatory diseases--where these services account for 65 percent of spending--than digestive diseases where these services account for 44 percent (see Table 2). The declining share of digestive-disease spending over the last 15 years might be partly explained by a relatively smaller Medicare subsidy for the digestive-disease category.

Although there was some movement in nominal spending shares reflecting other underlying factors, the relative stability of shares during a period when personal health spending had an annual growth rate of nearly 10 percent is worth noting. Forecasting consumer decisions requires that spending on disease categories first be deflated to constant dollars. This deflation, along with adjustment for demographic changes, should allow unique, disease-specific trends to emerge.

Table 2 displays input shares from the drug, hospital, and physician industries for the 18 disease treatment categories. The percentages accounted for by these "inputs" vary greatly across treatment categories. In 1995, hospitals accounted for only 20 percent of total spending on diseases of the nervous system, but 65 percent of spending on neoplasms. Physicians played a small role (10-11 percent) for mental disorders and diseases of the digestive system, but they accounted for a higher share of spending in diseases of the nervous system (32 percent) and the respiratory system (28.7 percent). The share of drug inputs varied from 1.5 to 13 percent in 1995 and was substantially lower than in 1972 and 1980 for most categories. Between 1972 and 1995, drug input shares rose only for mental disorders and diseases of the digestive system. About half the categories had declining drug shares of 3-5 percentage points, while in four categories, drug shares declined by more than 10 percentage points. These declines are what would be predicted by the structure of the Medicare subsidy. Since spending on drugs is the least-subsidized input, treatment programs using more hospital and physician inputs present lower relative prices to the consumer. Since some inputs are more amenable to technological change (i.e. drugs) this type of distortion may be having unintended dynamic consequences.

Where Do We Go From Here?

While this preliminary picture is interesting, we clearly have a long way to go in the development of consumer health goods accounts. There are two directions that can be simultaneously pursued. First, we can set up a set of accounts for 1992 through 1995 making use of the large amount of data that are already available. A key data source for this recent data on the over-65 population is HCFA's Medicare Current Beneficiary Survey (MCBS). This is a rich data source that was not available to researchers constructing the previous data on spending by disease. Then we could apply the Hodgson methodology, data from the National Center for Health Statistics' Hospital Discharge Survey, and the National Health Accounts produced by HCFA to develop estimates of spending by disease treatment for the under-65 population. Coincident with the development of nominal accounts would be work to begin developing price deflators for disease categories. One very important question is which disease categorization scheme to use. Medicare data are available at both the DRG (diagnosis related group) level, or the ICD-9 groupings. Data for the non-elderly, however, are available only under the ICD-9 definitions. The level of disaggregation for the disease categories is also important. Fortunately, if the health-consumption accounts are built from micro files, there is a considerable amount of disaggregation available.

A more immediate route for developing disease-treatment accounts would simply begin from the three available data points shown here. Rough estimates of deflators could be created using already existing studies where they are available. These preliminary time series would be used in a complete consumer demand system to estimate price and income elasticities and to forecast consumer health spending. The resulting income and price elasticities could then be compared with studies using the currently available NIPA data. While only a first approximation, these elasticity estimates and forecasts would be quite interesting in themselves and help determine whether there is indeed an empirical reason to more carefully develop other historical series.

Conclusion

In this paper, we have argued that if a traditional consumer demand approach is to be used to estimate key parameters for forecasting and policy analysis, the current NIPA data structure for health care spending will have to be changed. The issues involved appear to be: (1) the current set of accounts do not measure "goods", but where spending occurs, and (2) that focus makes it difficult to adequately adjust for quality in medical care treatment. We have noted that other analysts have developed a disease-treatment data set which can serve as the basis for ongoing work, and provide the examples to develop a richer data environment. We believe that a disease-treatment approach in the NIPA would tie together several disparate strands of work on disease incidence, quality of treatment, consumer health care spending, and federal budget policy analysis, and improve the underlying data structures on which federal medical care policy rest.

The issues of how health spending should grow is critically important not only to policy makers, but to the general public. How much life expectancy can continue to be increased and at what cost are essential pieces of information for the public to make informed decisions about how much to spend. Ultimately, the question of whether to build health consumption accounts rests on their potential contribution to these issues.

Endnotes

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the Office of National Health Statistics, HCFA and Margaret McCarthy of Inforum. This paper does not represent the position of the Health Care Financing Administration. Any errors are ours.

2. Board of Trustees, Federal Hospital Insurance Trust Fund (1997), p 30.

3. Board of Trustees, Federal Hospital Insurance Trust Fund (1997), p. 52

4. A clear, simple source explaining Medicare reimbursement is Waid (1997).

5. Monaco (1997) contains a description of the model and a comparative discussion of this model type, known as an interindustry-macro (IM) model, macro and AGE-CGE models.

6. This is a caricature of consumer demand theory. See any undergraduate intermediate microeconomics textbook for a more rigorous treatment, like Nicholson (1988) or Pindyck and Rubinfeld (1989).

7. The standard data source is the Survey of Current Business. Detailed annual consumer spending tables usually appear in the issues published just after annual revisions. The nominal data appear in NIPA Table 2.4; "inflation-adjusted" data are shown in billions of chain-weighted 1992 dollars appear in table 2.5. The most recent annual numbers appear in the July 1997 issue of the Survey. Data are also available through the Internet (http://www.bea.com/).

8. In "benchmark" years this is true. In other years, and for quarterly data, consumer spending at the published detail level is "moved forward" by the movements in closely related data series that are available in a more timely fashion, like retail sales data.

9. This information is taken from Personal Consumption Expenditures, Methodology Papers: U.S. National Income and Product Accounts (June 1990), p 23.

10. See The Boskin Commission Report and other papers on the overstatement of the CPI.

11. As a corollary, we are willing to believe that the average "price" of all possible goods purchased at a barber's shop is reasonably representative of all prices of all possible goods purchased at a barber's shop.

12. Likewise, it is hard to argue that the average "price" for hospital services is representative of the price of any arbitrary good purchased at a hospital.

13. There has been a veritable explosion of research and commentary on measuring quality change in the CPI, partially brought on by the findings of the Boskin Commission. Some key papers on the issue include Moulton (1996).

14. It is interesting to note that producer price indexes for hospitals have recently been developed that attempt to price "treatments" as opposed to "room charges" as is done in the current CPI. The inflation rate for hospitals using the PPI measure is substantially lower than that using the CPI measure.

15. SSA Population Area Projections: 1996, Actuarial Study #110 p. 8-18.

16. This is the definition of economic rent.

17. Some of this work is already being done (see OASDI Actuarial Note 107).

18. Hodgson (1984) developed a separate dissaggregation for people over age 65 for 1980, which will also soon be available for 1995, but the basic idea is amply illustrated with these numbers.

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Distribution of Personal Health Care Expenditures by Major Disease Category (ICD-9-CM), percent of health spending

Major Disease Categories	CODE	1972	1980	1995
Infectious and parasitic diseases	001-139	1.9	2.1	2.2
Neoplasms	140-239	5.1	6.2	5.4
Endocrine, Nutritional and metabolic diseases	240-279	4.6	3.5	4.3
Diseases of the blood and blood forming organs	280-289	0.7	0.5	0.6
Mental disorders	290-319	9.3	9.3	9.5
Diseases of the nervous system and sense organs	320-389	7.9	8.0	8.4
Diseases of the Circulatory system	390-459	14.5	15.1	16.9
Diseases of the respiratory system	460-519	7.9	7.9	7.8
Diseases of the digestive system	520-579	14.8	14.5	11.4
Diseases of the genitourinary system	580-629	5.9	6.0	4.8
Complications of pregnancy, childbirth and the puerperium	630-676	3.5		0.5
Diseases of the skin and subcutaneous tissue	680-709	2.0	2.8	2.4
Diseases of the Musculoskeletal system	710-739	4.8	6.2	6.4
Congenital anomalies	740-759	0.5	0.6	0.6
Injury and poisoning	800-999	6.8	8.8	9.1
Certain conditions originating in the perinatal period	760-779			0.4
Symptoms, signs and ill defined conditions	780-799	9.8	1.8	3.0
Supplementary classifications	v01-v82			6.3
Other			1.0	
Unallocated		16.8	5.6	12.0

Sources: Cooper and Rice (1976), Hodgson (1984), and Hodgson (forthcoming).

Hospital, Physician and Drug Shares of Spending

Major Disease Categories		HOSPITAL SHARE			PHYSICIAN SHARE			DRUG SHARE		
		1972	1980	1995	1972	1980	1995	1972	1980	1995
TOTAL	CODE	45	46	45.8	22	21	23.5	11	9	7
Infectious and parasitic diseases	001-139	47	48	53.4	24	34	27.8	14	18	10.7
Neoplasms	140-239	76	67	65.5	14	23	22.1	5	5	2.2
Endocrine, Nutritional and metabolic diseases	240-279	27	44	43.3	38	27	20.8	25	13	13.1
Diseases of the blood and blood forming organs	280-289	46	62	54	31	26	20.7	16	11	3.3
Mental disorders	290-319	75	63	57.8	10	10	10.4	6	5	8.1
Diseases of the nervous system and sense organs	320-389	17	25	20.1	22	26	32.7	10	12	5.2
Diseases of the Circulatory system	390-459	48	50	50.8	15	18	14.2	12	7	8.8
Diseases of the respiratory system	460-519	42	49	50.5	31	31	28.7	25	17	12.4
Diseases of the digestive system	520-579	36	36	32	8	12	11.4	4	3	5.4
Diseases of the genitourinary system	580-629	65	57	47.5	24	32	29.8	13	11	7.5
Complications of pregnancy, childbirth and the puerperium	630-676	89		59.7	6		37.9	3		1.6
Diseases of the skin and subcutaneous tissue	680-709	32	26	34.1	43	49	36.5	23	24	12.4
Diseases of the Musculoskeletal system	710-739	46	46	40.8	21	28	27.3	12	11	8.1
Congenital anomalies	740-759	82	65	54.1	12	27	25.2	2	7	0.4
Injury and poisoning	800-999	61	60	56.3	24	25	27.1	7	10	1.4
Certain conditions originating in the perinatal period	760-779			75.6			15.1			0.1
Symptoms, signs and ill defined conditions	780-799		43	32.7		37	36.1		20	8.3
Supplementary classifications	v01-v82			43.6			49			3.7
Unallocated		11	78		58	17		17	5	

Sources: Cooper and Rice (1976), Hodgson (1984), and Hodgson (forthcoming)

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